THE DENTAL PRACTITIONER

AND DENTAL RECORD

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THE DENTAL PRACTITIONER
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Vol. IX, No. 4 December, 1958

EDITORIAL

THE STUDY OF CHILDREN'S DENTISTRY

THE ultimate outcome of dental research must be surely reflected in the oral health of the community. The first thought that leads to the possibility for a research project goes through many phases of frustration and hard work before finally finishing with clinical observations in the mouth. In some ways the final assessment of practical research will lie in the hands of the general practitioner.

In the field of children's dentistry it is essential that there is complete co-operation between all sections of the interested parties. With this end in view, a small Study Circle in Children's Dentistry was formed in London just after the war. It consisted of a group of research workers, teachers, and general practitioners (including orthodontists and School Dental Officers), who met to discuss the problems involved in this aspect of dentistry. This Study Circle has now decided that it is time to enlarge itself into a small Society.

It is unfortunate that most dental societies, being centred on London, become in effect a society for those people residing around London, to the detriment of those in the provinces. Fortunately there has been a tendency for these 'national' societies to meet once or twice a year outside London to stimulate interest in those members of the society who live a long distance away from its centre. The newly formed London Society for the Study of Dentistry for Children has specifically stated that its intention is to form a Society for those residing in and around London, in the hope that each city in the country will form its own society, each independent of the London centre. This is a laudable object and we hope that it will be taken up over a wide area, and that these small societies with this special interest will be formed, as indeed some of them are already in being. If the idea grows, the time may arrive for a true national society, but with a sense of individuality within each section. There is no doubt that since the war a much greater interest has been taken in the treatment of children, and undoubtedly many practitioners have been stimulated by the efforts of small groups, and also by the new approach of dental schools to the teaching of this subject. All too often it was left until the late stages of studentship, so that on qualification there was no incentive to carry on a practice dealing with children. Modern teaching has shown that it is in fact just as easy to teach a student to treat a child as it is to treat an adult. The formation of these societies will fill a need, for it is only then that the profession will expand into the field of true prevention.

Those interested in this project should write to the London Society for the Study of Dentistry for Children, whose secretary is Mr. J. S. Rose, The London Hospital Dental School, Turner Street, London, E.1.

CHANGES IN FACIAL PROFILE

By **HALLAM GRESHAM,** D.D.S.

Senior Lecturer in Orthodontics, University of Otago Dental School, Dunedin, New Zealand

THE patient whose mandible is postnormal is suffering from a severe handicap. In order to improve the profile of such patients it is necessary to encourage the mandible to take up a new forward position; for such improvement in profile to become permanent the growth pattern of the face has to be altered. Rogers (1935) claims such a result following myofunctional therapy, while Andresen and Haupl (1945), Hoffer (1951), Sved (1948), and others believe that an improvement in mandibular position can be achieved and made permanent by removable appliance therapy. On the other hand Ballard (1955), Björk (1951), and Oppenheim (1935) are among those who deny the possibility that a new forward position of the mandible can be permanently achieved. We thus have a conflict of opinion in this matter.

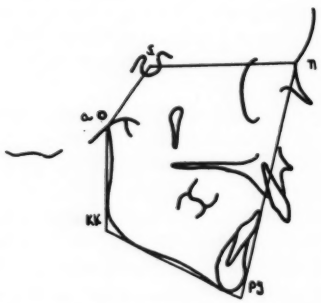


Fig. 1.—Reference points used in this study.

In 1950, twenty Angle Class II patients were selected and treated by Andresen therapy for periods varying from 6 to 16 months, the mean period of treatment being 12 months. In the selection of these patients only one criterion for suitability was employed, viz., that true mandibular post-normality was evident as part of the dysplasia. Twenty Angle Class II patients of similar age and sex were used as controls. Using cephalometric radiography, a comparison of these treated and untreated groups was made. Of the group of 20 patients treated, 14 showed a significant forward movement of the mandible in occlusion. One of the findings of this investigation (1950–51), as reported (Gresham, 1952), was "a significant improvement in the occlusal position of the mandible, involving æsthetics and function, can be achieved by the use of Andresen therapy in the treatment of Angle Class II malocclusion".

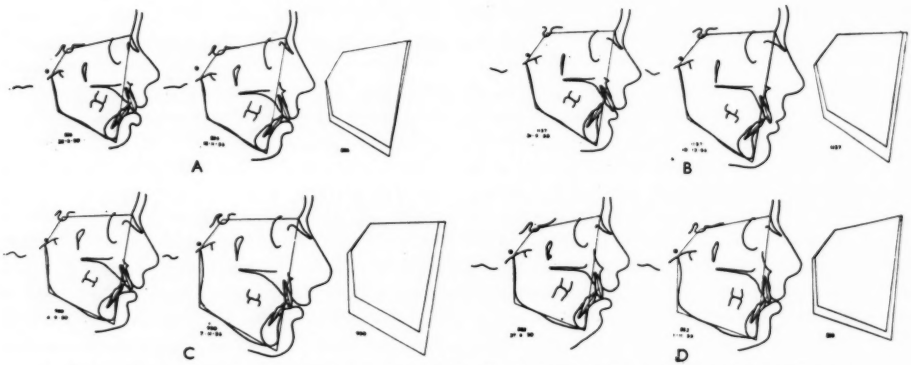


Fig. 2.—Tracings before and after treatment, and profile diagrams orientated on cranial base line s n.

Of this group of 14 patients who showed a significant change immediately following

treatment, 12 were available for further cephalometric radiographs to be taken at periods varying from 10 to 18 months (mean period 14½ months) after appliance therapy had been completed. No retrogression in occlusal position was apparent in this second radiographic examination. The writer stated at that time (1953), "a permanent improvement in mandibular position can be achieved in the treatment of Angle Class II malocclusion by Andresen therapy" (Gresham, 1953 a).

In a recent publication Wylie (1956) discusses whether the orthodontist's role is that of "innocent bystander or prime mover in facial growth". The present investigation was undertaken to test the validity of the writer's statement quoted above (Gresham, 1953 a), which implied that the orthodontist's role when repositioning the mandible was more than just that of an innocent bystander.

A third cephalometric examination of the individual facial profiles of 12 Angle Class II patients treated by Andresen therapy more than five and a half years ago has recently been undertaken. Twelve patients of similar age and sex were selected from the original Angle Class II control group of 20 patients, and a cephalometric examination of the individual facial profiles of these patients has been made. A comparison of the individual and mean facial profiles of these two groups, one treated by Andresen therapy and the other group untreated, is described and discussed.

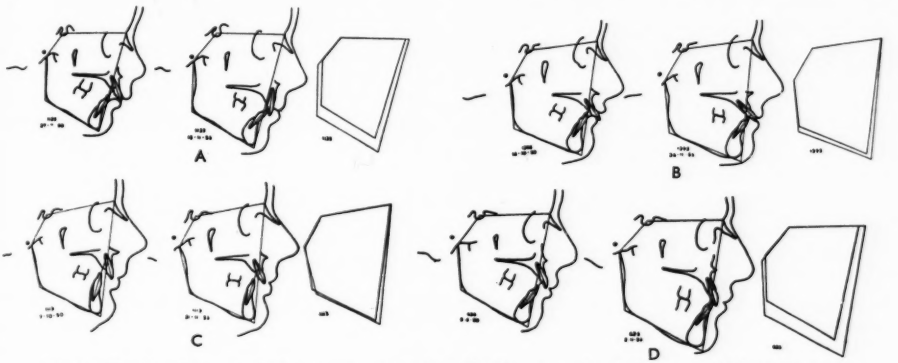


Fig. 3.—Tracings before and after treatment, and profile diagrams orientated on cranial base line s n.

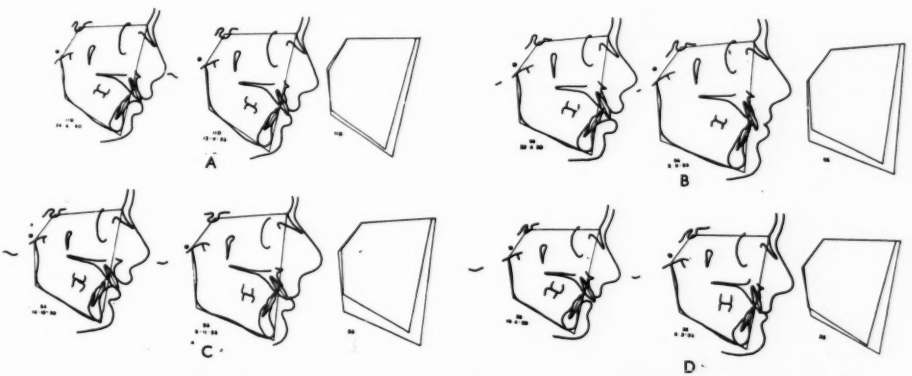


Fig. 4.—Tracings before and after treatment, and profile diagrams orientated on cranial base line s n.

METHOD

From the cephalometric radiographs of each individual a profile diagram was constructed using the following reference points (Björk, 1947):—

s. The centre of sella turcica.

n. Nasion. The anterior limit of suture naso-frontalis.

pg. Pogonion. The most prominent point on the chin.

kk. The point of intersection between the base and ramus tangents to the mandible. The midpoint is used where double projection gives rise to two points.

a. Articulare. The point of intersection of the dorsal contours of processus articularis mandibulæ and os temporale. The midpoint is used where double projection gives rise to two points. (*Fig.* 1.)

Tracings from the cephalometric radiographs of the treated patients are shown in *Figs.* 2, 3, and 4. Using s as a stable point, the two profile diagrams for each patient were orientated on the cranial base line s n. Change in the relationship of the mandible to the cranium may be gauged by alterations in angle s n pg.

In patient 826 (*Fig.* 2 A) the mandible is more post-normal in 1956 than it was in 1950 before treatment—failure to reposition the jaw. Some improvement in tone and posture of the lips is evident. In patients 1157 (*Fig.* 2 B) and 930 (*Fig.* 2 C), no repositioning of the mandible has occurred; improvement in profile is related to the increased vertical height of the face. Patients 852 (*Fig.* 2 D), 1125 (*Fig.* 3 A), 1395 (*Fig.* 3 B), and 1113 (*Fig.* 3 C) show some forward change in mandibular position with varying degrees of improvement in profile. A very definite change for the better is apparent in the profiles of patients 626 (*Fig.* 3 D), 110 (*Fig.* 4 A), 96 (*Fig.* 4 B), 56 (*Fig.* 4 C), and 25 (*Fig.* 4 D). A forward change in relationship of mandible to cranium is evident with improvement in lip posture and tone.

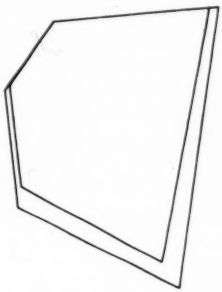


Fig. 5.—Mean group alteration in profile diagram before and after treatment.

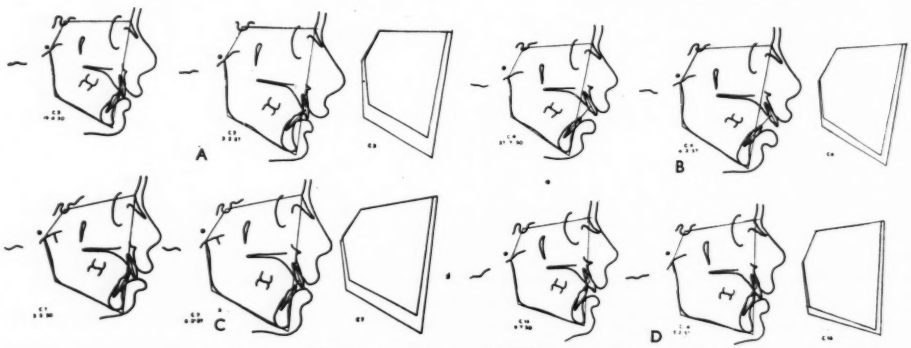


Fig. 6.—Typical tracings and profile diagrams of untreated patients.

A mean profile diagram for the group of twelve patients before treatment and a similar diagram for the group after treatment was constructed. *Fig.* 5 shows these two mean profile diagrams orientated on the cranial

base line s n, using s as a stable point. There is a mean increase in angle s n pg of 2·4°. The first cephalometric radiograph was taken in 1950 before treatment. After a mean treatment period of 12 months, therapy was discontinued. Growth of the face and jaws, uninfluenced by therapy continued for the following 5 years when the second cephalometric radiograph was taken. The 2·4° mean increase in angle s n pg is thus due to Andresen therapy and growth.

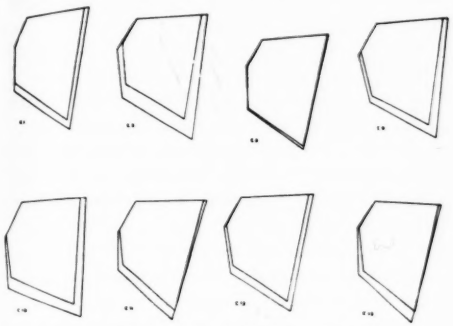


Fig. 7.—Profile diagrams of untreated patients.

Tracings from the cephalometric radiographs and orientated profile diagrams of four typical untreated patients in the control group are shown in *Fig.* 6. The improvement in profile due to therapy is shown by a comparison of the tracings in *Figs.* 2, 3, and 4 with those in *Fig.* 6. Profile diagrams only of the other eight untreated patients are shown in *Fig.* 7. In some individuals, growth in vertical height of the face tends to be greater than growth in a forward direction, patients C3 (*Fig.* 6 A) and C7 (*Fig.* 6 C). This trend is even more apparent in patients C11 and C13 (*Fig.* 7). In other individuals horizontal growth is greater than vertical growth, patients C4 (*Fig.* 6 B) and C14 (*Fig.* 6 D). This has been pointed out by Downs (1948): "there is a notable deviation on both sides of the mean finding of the facial pattern".

A mean profile diagram for the control group based upon radiographs taken in 1950 was constructed. A second mean profile diagram based upon radiographs taken for these same patients in 1957 was constructed. *Fig.* 8 shows these two mean profile diagrams orientated on the cranial base line s n, using s as a stable point. There is a mean increase in angle s n pg of 0·5°. This group of similar malocclusion, age, and sex distribution (6 male, 6 female) to the treatment group, remained untreated in the period between the two cephalometric radiographs. In the control group the 0·5° mean increase in angle s n pg is due to growth only.

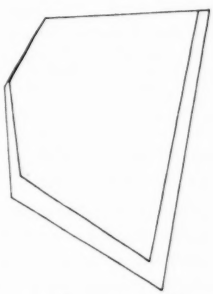


Fig. 8.—Mean group alteration in profile diagram of untreated patients.

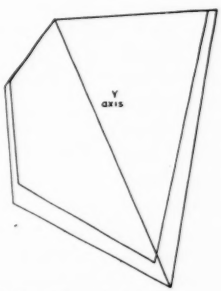


Fig. 9.—Mean facial diagrams of treatment group in relation to the Y axis.

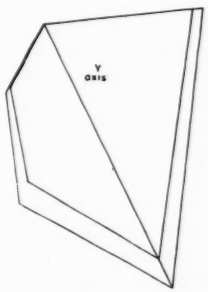


Fig. 10.—Mean facial diagrams of the control group in relation to the Y axis.

It appears then that the difference of 1·9° in the mean increase in angle s n pg between the two groups of patients has occurred as a result of the Andresen therapy. The difference in this angular increase is significant, as shown by the observed "t" value of 5·4 in *Table I.*

Further evidence that the mandible has been repositioned forward in the treatment group

as compared with the control group can be shown by an examination of the Y axis in relation to the mean facial diagram of each group. Downs (1948) states "as the face swings out from under the cranium in its growth and development from birth to maturity, it is said to grow in a downward and forward direction.

Table I.—Significance of Change in Mandibular Position, Group (12 Patients) treated by Andresen Therapy

	Mean Difference in Angle s n pg over the Observed Period	*Difference in Means*	*Standard Error of Difference*	"*t*"	*P*
Treatment Group	2·4°	1·9°	0·35	5·4	less than 0·01*
Control Group	0·5°				

* "*t*" 0·01 with 22 degrees of freedom = 2·819

A line from sella turcia to gnathion has been used as an expression of the direction of this growth and called the Y axis." *Fig.* 9 shows the mean facial diagrams of the treatment group in relation to the Y axis. It is apparent that the horizontal or forward growth of the face in this group is greater than the growth in facial height. *Fig.* 10 shows the mean facial diagrams of the control group in relation to the Y axis. In the control group as a whole, individual deviations on both sides of the mean disappear, and the path of growth of the chin point is along the Y axis. Comparing the position of the chin point in relation to the Y axis in *Figs.* 9 and 10, the direction of growth of the chin point in the treatment group differs from the direction of growth of the chin point in the control group. The treatment group chin is repositioned forward and it appears to be logical to assume that the Andresen therapy is responsible for this difference in the growth pattern of the face between the two groups.

CONCLUSIONS

Evidence is put forward which seems to point that the orthodontist's role was somewhat more than that of an "innocent bystander" in the facial growth of the group of 12 patients reported upon in this investigation.

Some improvement in mandibular position may be expected, with a concurrent change for the better in facial profile, by the use of Andresen therapy in specially selected Angle Class II patients.

Criteria for selection are:—

1. A true post-normal mandible.

2. Maxillary and mandibular arch width such that "at the commencement of treatment . . . a correct occlusion of buccal teeth is possible when the mandible is brought forward to a position of neutroclusion" (Gresham, 1953 b).

3. Average incisal overbite.

REFERENCES

Andresen, V., and Haupl, K. (1945), *Funktions Kieferorthopadie Die Grundlagen des "norwegischen systems"*. 4th ed. Leipzig: J. A. Barth.

Ballard, C. F. (1955), *Dent. Practit.*, **6**, 80.

Björk, Arne (1947), *Svensk tandläk. Tidskr.*, **40**, No. 5B.

— — (1951), *Amer. J. Orthodont.*, **37**, 437.

Downs, William B. (1948), *Ibid.*, **34**, 812.

Gresham, Hallam (1952), *N. Z. dent. J.*, **48**, 10.

— — (1953 a), *Ibid.*, **49**, 117.

— — (1953 b), *Austr. J. Dent.*, **57**, 316.

Hoffer, Oscar (1951), *Internat. Dent. J., Lond.*, **1**, 98.

Oppenheim, Albin (1935), *Int. J. Orthod.*, **21**, 333.

Rogers, A. P. (1935), *Ibid.*, **21**, 426.

Sved, Alexander (1948), *Amer. J. Orthodont*, **34**, 549.

Wylie, Wendell L. (1956), *Oral Surg.*, **9**, 985.

The Use of Heterogeneous Anorganic Bone in Periodontal Bone-Grafting

Anorganic bone, prepared by treating ox-shin bone with ethylenediamine, was placed in glass ampoules and autoclaved at 110°C. for one hour and stored at room temperature. Following routine prophylaxis and root planing, the teeth to be treated were splinted and occlusal equilibration was obtained. Flaps were raised and the area cleared so that only blood-clot remained. Anorganic bone-chip was then positioned and the flaps were replaced and sutured.

The treatment was evaluated clinically and radiologically at intervals to eight months after operation. In all cases the anorganic bone was found to be acceptable. Alveolar bone had regenerated in fairly substantial amounts, but regeneration in the supracrestal region was slight.—Melcher, A. H. (1958), *J. dent. Ass. S. Afr.*, **13**, 80.

RADIATION HAZARDS: SOME RECENT WARNINGS ON EXPOSURE TO X-RAY RADIATION THAT SHOULD BE ANNOUNCED TO ALL DENTISTS*

By JAMES A. ENGLISH, B.S., D.D.S., M.S., Ph.D., *U.S. Navy*

THE subject of radiation hazards has been prominent in newspapers and popular magazines during the past year or two. The reason for the increased interest is partly due to controversial opinions expressed by scientists about the significance of radiation due to fall-out from atomic bomb detonations. Newspapers are quick to pick up controversial items because they can arouse a continuing interest among their readers. There have also been popularized medical items in the newspapers relating diagnostic radiation-procedures to leukæmia and genetic damage in patients. These articles have either arisen from reports of clinical investigations, in which the records of large numbers of patients have been studied to see whether harmful effects have been caused by X rays, or they have resulted from reports of animal experimentation. Some professional men have expressed regret that patients should have been exposed to this controversial information, or to popularized medical items, for the reason that patients then raise questions about radiological procedures. Some patients have even refused to be X-rayed. However, the increase in public interest in radiation procedures may eventually be beneficial, for it requires that physicians and dentists install more safety precautions in their clinical radiological procedures—and there is ample evidence that insufficient caution has existed. I wish to say more about several of the specific reports that have aroused this public interest, but first I would like to review some background information that is necessary to an understanding of the subject. I will devote little space to this because I know that, as clinicians, we are primarily interested in those facts which can be directly applied to the practice of dentistry.

First, we must define the kind of radiation we are considering. As we all know, the differences between X rays, visible light, radiated heat, and radio-waves are really academic, because they represent similar kinds of energy from a physics point of view. They are transmitted in the same way and at the same speed (186,000 miles per second or 300,000 kilometres per second). The difference between these kinds of radiation is primarily a matter of wave-length, although of course there are different energies involved at the radiation source. This may be visualized by remembering how metal changes in colour from dull red through bright red, orange, and yellow as you increase the heat of your burn-out oven. *Fig.* 1 shows the relative wave-lengths of various kinds of radiation, and I wish to point out several of the things illustrated in *Fig.* 1:—

1. The wave-length region which is referred to as X rays is quite broad, extending from 0·06 Å to 120 Å (1 Å = 1×10^{-8} cm.). It is important to recognize that the word "X-ray" does not refer to a single wave-length, because the differences between short wave-length and long wave-length X rays are biologically more important than the difference between green and red visible light. This will be amplified later.

2. The boundary between long X rays and short ultraviolet rays is actually arbitrary.

3. The visible band of radiation is only a small zone of the total spectrum. It is drawn in an expanded scale in the lower part of *Fig.* 1, in order to show the elementary colours.

4. Some biological phenomena are related with most of these radiations; however, the quantitative effects tend to decrease with increasing wave-length.

* A paper delivered to the American Dental Society of Europe, August 28, 1957.

Sometimes the electromagnetic radiations below about 120 Å wave-length are placed in a common category with alpha, beta, and neutron radiation, and referred to as "ionizing radiation". This simply refers to the fact that these radiations have sufficient energy to produce ionization of atoms, and in fact their ability to damage biological structures is probably related to this ionization. This lecture pertains to X rays, because of their use in dental practice. However, the same kinds of effects are produced by all of the ionizing radiations.

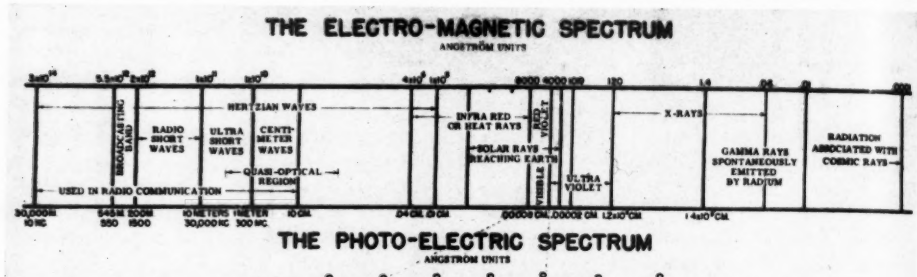


Fig. 1.—The electromagnetic spectrum, from *Handbook of Radiation Physics*, published by Naval Medical Hospital.

Having specified the kind of radiation we are considering, we must now clarify our units of measurement. As you know, X-ray radiation is measured in roentgens, which are defined as that radiation which will produce one electrostatic unit of charge in 1 c.c. of air under standard conditions. This definition has little meaning unless one is working in a physics laboratory. For this reason I have listed in *Table I* the dose of X rays which will kill 50 per cent of experimental animals within 30 days after a total-body exposure, and also the doses which will kill a perceptible number of certain kinds of cells.

Although these figures are approximations collected from the general literature, it is of interest to see that different animals and different cells show a marked variability in their sensitivity to radiation. Please note that doses as low as 175 r can kill an animal and 50 r can kill certain cells, for this is an important concept in our later discussion.

Having an idea of the units of radiation and what they mean in terms of death to certain animals and cells we will discuss various concepts of permissible doses of radiation to man. The Atomic Energy Commission of America operates on the basis that human beings can be exposed to a total-body radiation of 0·3 r per week with reasonable safety.

Table I.—X-RAY DOSE RELATIONSHIPS

(A Roentgen is that radiation which will produce 1 E.S.U. of charge in 1 c.c. of air under standard conditions)

The 50 per cent Lethal Dose for Animals	L.D.50/30
Guinea-pigs	175 r
Dogs	375 r
Rats	600 r
Rabbits	800 r
Dose required to give Evidence of Death to Cells	
Spermatogonia	50 r
Spermatocytes	800 r
Lymphocytes	50 r

This is a somewhat arbitrary value, arrived at by extrapolation downward from much larger doses which can produce observable

effects. At the rate of 0·3 r a week, a person would get about 15 r a year. The Medical Research Council of Great Britain believes that somatic tissues (such as the skin) may safely receive a total of 200 r in a lifetime, but that reproductive tissues should only receive 50 r during a person's reproductive life. It should be emphasized that all of these values

Table II.—X-RAY SKIN DOSE COMPARISONS (SINGLE EXPOSURE)

Number of Films	*Film Type*	*Voltage*	*Filtration*	*Dose*
Single	Regular	65 kV	0	10 r
Full mouth (14)	Regular	65 kV	0	140 r
Single	Regular	65 kV	1 mm. Al.	5 r
Full mouth	Regular	65 kV	1 mm. Al.	70 r
Single	Regular	70 kV	3 mm. Al.	2 r
Full mouth	Regular	70 kV	3 mm. Al.	28 r
Single	Fast	70 kV	3 mm. Al.	0·7 r
Full mouth	Fast	70 kV	3 mm. Al.	9·8 r

are arbitrary and subject to some differences in opinion. For example, most geneticists believe that *any* increase in radiation to the gonads deserves very serious consideration, because unlike somatic cells there is no threshold dose below which changes do not occur, and there is no recovery from radiation damage in the same sense as there would be in other tissues of the body.

Let us now examine our clinical practice of dentistry to see how much radiation is produced in various techniques, decide whether these amounts of radiation are of any consequence, and then see what can be done about reducing the doses our patients receive.

In *Table II* I have given data which have been collected by Blackman (1957). This slide shows that a single dental exposure may produce 10 r, if regular film is used, without filtration. Doses to some parts of the head may be 40–140 r if one takes a full-mouth series of 14 pictures. With 1 mm. of Al. filtration these doses may be cut in half. With 3 mm. Al. filtration, the 10 r skin dose will be reduced to 2 r, even though the kilovoltage is increased to 70 in order to provide proper density. By using fast film this dose can be reduced to 0·7 r. Now I wish to point out that the order of magnitude of 140 r is not to be laughed off lightly when one remembers that a total-body radiation of 175 r can kill an animal.

At this point I wish to refer to some recent reports indicating that a positive relationship

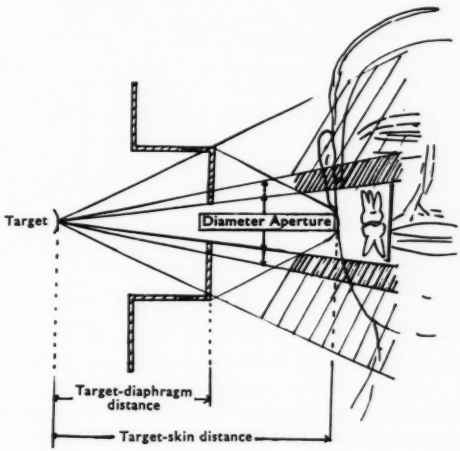
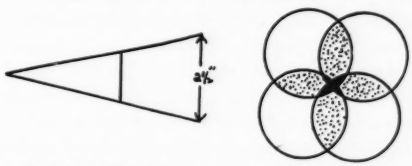


Fig. 2.

exists between leukæmia and diagnostic doses of radiation. Of course it has been clearly established that malignant disease may be caused by exposure to single, or two or three



Desired field of primary beam = 2½ in. (9 cm.)

$$\frac{\text{Diameter of Aperture}}{\text{Diameter of Field}} = \frac{\text{Target–Diaphragm distance}}{\text{Target–Skin distance}}$$

$$\frac{X}{2\frac{1}{2}} = \frac{4}{8} \qquad X = 1\frac{1}{4} \text{ in.} = 4{\cdot}5 \text{ cm.}$$

If X = 4·5 cm., the field is 63 sq. cm.; if X = 5·0 cm., the field is 78·5 sq. cm. This is a 20 per cent increase.

Fig. 3.

large doses of radiation, such as given to patients with ankylosing spondylitis (W. M. Court-Brown, 1957), to children with enlarged thymus glands (Simpson, Hempelmann, and

Fuller, 1955), or as received by the victims of the Hiroshima atomic bomb detonation (Moloney and Kastenbaum, 1955). Of more direct importance to you is the series of reports, like that of Shields Warren (1957), which shows that physicians who are exposed to radiation in their practices develop a considerably higher incidence of leukæmia than non-radiologists. However, the startling reports are those of Alice Stewart (1956) of England who shows that in children with leukæmia, twice as many had been irradiated in utero as in a control group whose mothers had not been diagnostically irradiated during pregnancy. Another report by Faber (1956) of Copenhagen shows that among 828 leukæmia patients receiving various kinds of radiation, the incidence of leukæmia is considerably higher than in the control groups. Even though all scientists are not in accord with those findings that indicate leukæmia may be caused by single X-ray exposures, we must remember that our patients not only get several full-mouth series of exposures to radiation from dentists but they also receive other medical exposures.

Some dentists have asked me how many full-mouth sets of dental radiographs can safely be made. The answer to this depends upon the techniques which one uses in taking one's pictures. One important factor in making radiology safer is to reduce the area of the body which is exposed in making the radiograph. *Fig.* 2 is a drawing which shows how the field of radiation can be reduced by having a proper diaphragm in the machine. As you see, the X rays originate from the tungsten anticathode or *target* and radiate in all directions. They are stopped by the metal housing around the X-ray tube, and can only pass through the aperture in the diaphragm. If one removes the cone from the dental X-ray machine, one may be removing the diaphragm altogether. If radiographs are taken under these conditions, the whole head and neck of the patient will be exposed. This is extremely poor technique. If the aperture is reduced in size, it can be seen from the diagram that the field of exposure is also reduced. The X-ray field should be slightly larger than the film being used in order to permit the operator a little latitude in positioning his machine.

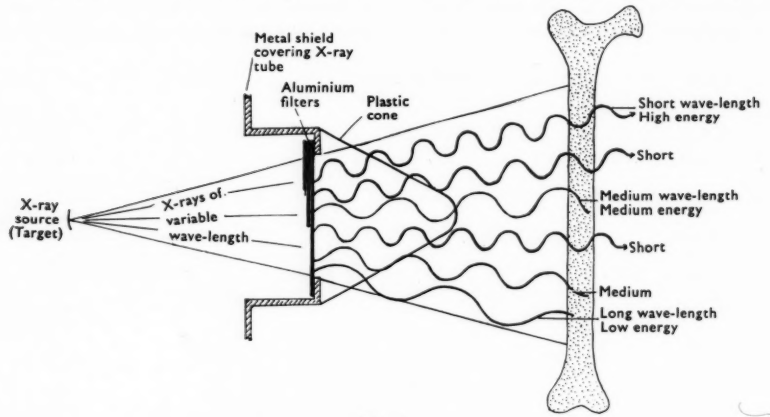


Fig. 4.

The next illustration (*Fig.* 3) shows that in taking a full-mouth series of pictures there is an overlapping of fields, that is, the field for the radiograph for the molar teeth will overlap the field for the premolar teeth; and the field for the upper teeth will overlap the field for the lower teeth. Thus, there are certain areas of skin which are exposed four times in taking a full-mouth series of X rays. By reducing the radiographic field, the amount of overlapping is reduced. The size of the field is related to the size of the aperture (X) and the distance from

the target (T) to the diaphragm, and the distance from the target to the patient's face. For most dental radiography a field of 2½ in. (9 cm.) is adequate. The simple calculation illustrated (*Fig.* 3) shows that you can determine how large the opening in your diaphragm must be to establish this size field. In an article by Richards (1957) the target-diaphragm distances

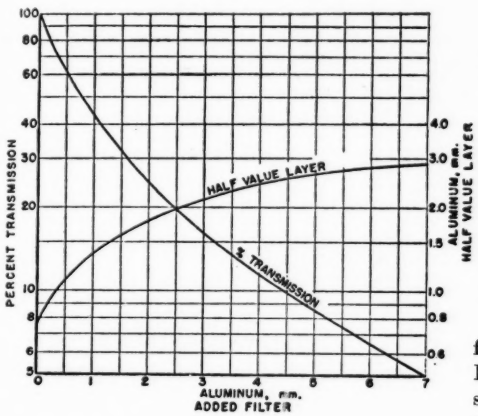


Fig. 5.

for most kinds of X-ray machines are listed. In the example shown, the size of the aperture is calculated to be 1¼ in. (4½ cm.). It is interesting to note that the field then measures 63 sq. cm., but if the aperture is increased ½ cm. in diameter the field then becomes 78·5 sq. cm.

Another important factor in deciding how many X rays can be taken with safety is the amount of filtration used. In *Fig.* 4 the purpose of using filters is illustrated. X rays of variable wave-length arise from the target of the X-ray tube. At the lower part of the aperture there is one layer of aluminium, which permits long, medium, and short wave-length X rays to pass through. The long wave-length X rays cannot get through the skin, and for purposes of illustration we show the long and medium wave-length X rays being stopped by the bone. When two layers of aluminium are used, the long wave-length X rays are eliminated, and when three layers are used, only the relatively short high-energy wave-length X rays remain. The relatively long X rays which have been eliminated did not contribute to our X-ray picture anyway, since they were unable to get through the skin and flesh; however, they did add to the skin dose.

The next illustration (*Fig.* 5) from a paper by Scott Smith (1955) gives a physical basis for determining how much filtration to use. In this chart the percentage transmission is shown on the vertical, and mm. of Al. filtration added is shown on the horizontal. It will be seen that percentage transmission drops rapidly as aluminium is added, which means that the quality of the radiation is changing rapidly. Less than ½ mm. of Al. will cut the transmission in half, whereas 2 mm. will reduce it by 75 per cent. Beyond this point the quality does not change much with added filtration, for most of the long wave-length X rays have already been eliminated. For this reason it may be seen that to use more than about 2 or 2½ mm. of aluminium would be impractical.

Table III.—Calculating Permissible Number of Exposures

Total Permissible Dose (M.R.C.)		200 r
If dose per film	=10	
Some areas receive in full-mouth record	=40	40 × 5=200 r
If dose per film	= 2	
Some areas receive in full-mouth record	= 8	8 × 25=200 r
If dose per film	= 0·7	
Some areas receive in full-mouth record	= 2·8	2·8 × 70=200 r

This is only considering the *skin* dose.
Centrally located tissues may be receiving greater doses.

Now let us calculate how many full-mouth X-ray examinations we can safely make per patient. *Table III* shows that when each film delivers 10 r some parts of the face receive 40 r, so with the Medical Research Council permissible dose limit set at 200 r, only five full sets could be taken. With filtration, the exposure dose can be reduced to 2 r and some areas will still receive 8 r; thus, 25 full-mouth sets would be possible. If one uses fast film the single exposure dose can be reduced to 0·7 r and 70 sets of pictures would be possible. We must remember, however, that other than

dental X rays are needed, and that central parts of the head can be getting exposures from all 14 pictures of the set. Thus, even under the best techniques, only necessary pictures should be taken.

Some concern has been expressed about the gonadal dose patients receive in dental radiology. Two recent studies are available pertaining to this, and *Table IV* gives data from one of them. Stanford and Vance (1955) took measurements under frequently existing conditions (65 kV., 10 mA., 8 in. TSD, 1·0 mm. Al. filtration). Under these conditions a full-mouth set of 14 pictures gave men a gonadal dose of 4·75 mr with fast film and 0·015 r with intermediate speed film. Using the latter film, 20 complete mouth X rays would deliver a gonadal dose of 0·3 r to men and 0·05 r to women. This is less than a tenth of the unavoidable background dose received in 30 years and is well within established limits. Recent correspondence with Scott Smith of the National Bureau of Standards indicates that he has obtained values of the same order of magnitude as Stanford and Vance, whereas Budowsky (1956) has published somewhat higher values. The values given indicate that probably genetic damage is not the primary problem in dental radiology. To be exceptionally safe, one could put a lead apron over the laps of children and young adults, particularly when occlusal-type films are taken.

Table IV.—X-ray Gonadal Dose Relationships

Established limits: M.R.C., Great Britain	50 r
N.R.C., U.S.A.	10 r
Gonadal dose, received in dental roentgenography, 65 kV, 10 mA, 8 in. TSD, filtration (inherent) 1·0 mm. Al.	
1 Fast film (for men)	0·00034 r (0·34 mr)
14 Fast films (for men)	0·00475 r (4·75 mr)
14 Intermediate films (for men)	0·01425 r
20 Complete mouth X rays (for men)	0·3 r
20 Complete mouth X rays (for women)	0·05 r
Unavoidable background exposure for 30 years	4·5 r

An example is given (*Table V*) of how one corrects one's exposure-time for changes in technique, based on Richards's publication. Since radiation dosage is reduced by the square of the distance from the target, substitution of an 8 in. cone for a 6 in. cone increases the exposure time by a factor of 1·77, but at the same time there is a skin dose reduction of 23 per cent because there is a reduction in long-wave X rays which reach the skin. A kilovoltage increase from 65 to 85 requires a reduction in dose by a factor of 0·37. However, if one adds filtration at the same time, such a change in kilovoltage is necessary, and little reduction in exposure time may be needed. Thus, a 60 per cent skin-dose reduction may be gained by simultaneously adding 2 mm. Al. filtration and increasing the kilovoltage. The most important single change that can be made in technique is to change to fast film. This not only reduces the skin dose, but the total dose to the head is reduced by as much as 92 per cent. By increasing one's developing time, it is also possible to reduce the exposure time by 25 per cent. By multiplying all of these factors, the final correction factor is obtained. Such changes may reduce patient skin dose by a total of 200 per cent.

Table V.—Example of Exposure-time Correction

	From	*To*	*Factor*	*Approx. Skin-dose Reduction* per cent
Target-skin distance	6 in.	8 in.	1·77	23
Kilovoltage	65	85	0·37	—
Aluminium filter	0·5 mm.	2·5 mm.	(kV change)	60
Film type	Regular	Ultra-speed	0·08	92
Developing time	3·5 min.	5 min.	0·75	25

Time Factor = 1·77 × 0·37 × 0·08 × 0·75 = 0·036.
Skin-dose Reduction = 200 per cent.

REFERENCES

Blackman, S. (1957), *Brit. dent. J.*, **102**, 171.
Budowsky, Jack, *et al.* (1956), *J. Amer. dent Ass.*, **52**, 555.
Court-Brown, W. M., and Doll, R. (1957), Medical Research Council (U.K.), Special report series No. 295.
Faber, M. (1956), Paper read at Fifth International Conference on Radiobiology, Stockholm.
Medical Research Council (U.K.), (1956), Cmd. 9780.
Moloney, W. C., and Kastenbaum, M. A. (1955), *Science*, **121**, 308.
Richards, Albert G. (1957), *J. Amer. dent. Ass.*, **54**, 476.
Simpson, C. L., Hempelmann, L. H., and Fuller, L. M. (1955), *Radiology*, **64**, 840.
Smith, Scott W. (1955), *J. Amer. dent. Ass.*, **51**, 12.
Stanford, R. W., and Vance, J. (1955), *Brit. J. Radiol.*, N.S. **28**, 266.
Stewart, A. (1956), *Lancet, Lond.*, **2**, 447.
Warren, S. (1957), *Sci. Mon.*, **84**, 3.

THE USE OF THIOPENTONE AND MUSCLE RELAXANTS IN THE AMBULATORY DENTAL PATIENT

WITH SPECIAL REFERENCE TO THE CONTINUOUS INTRAVENOUS SUCCINYLCHOLINE DRIP

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ANY operative procedure carried out on the mouth under general anæsthesia demands security and adequacy of the airway and avoidance of obstruction or inspiration of foreign matter and mucus.

For the more lengthy procedures, especially in the molar regions, endotracheal anæsthesia offers the advantages of a secure and adequate airway and permits effective packing of the oropharynx without interfering with the field of operation. Adequate surgery may then be performed in an unhurried fashion, with proper attention to detail.

Hitherto, it has been considered necessary for the patient to be admitted to hospital for the administration of endotracheal anæsthesia. The following study has been made in an attempt to find the most satisfactory combination of agents from the point of view of patient, surgeon, and anæsthetist, giving safety and good operating conditions in the ambulatory patient.

A brief account of the relevant pharmacology of thiopentone and relaxant drugs is given, showing the rationale and development of the technique adopted.

THIOPENTONE

Thiopentone is an "ultra short acting" thiobarbiturate and produces a rapid, pleasant, induction of anæsthesia. Initially the depth of narcosis is dependent upon the circulating blood-level, but, as anæsthesia progresses, the central nervous system develops an acute tolerance to the drug (Brodie, 1952; Dundee, 1956 a, b). Following high peak blood-levels or prolonged anæsthesia, the blood-level on awakening is higher than that normally required to produce profound narcosis.

Using single injection techniques, the blood-level on awakening is found to be directly related to the peak blood-level (Dundee, 1956 a, b). The blood-concentration falls rapidly, mainly due to diffusion of the drug to the tissues (Brodie, Mark, Papper, Lief, Bernstein, and Rovenstine, 1950; Brodie, Bernstein, and Mark, 1952; Shideman, Gould, Winters, Peterson, and Wilner, 1953); the rate of diffusion varies with the concentration gradient. An increase in the rate of administration of thiopentone gives an increase in the peak blood-level; there is a consequent rise in the blood-level at which consciousness returns and an increase in the rate of fall to that level. Thus by increasing the rate of administration and reducing the dose of thiopentone it is possible to produce an equivalent initial depth of narcosis, with a reduction in its duration.

For out-patient use, it would appear that the optimum dose of thiopentone is a small one given fairly rapidly, to produce an adequate depth of narcosis and a rapid return to consciousness. However, a rapid injection also gives rise to a sudden high concentration of the drug in the coronary circulation; the resulting myocardial depression, coupled with the peripheral vasodilatation produced by thiopentone, may precipitate a fatal cardiac failure in unsuitable subjects (e.g., the aged and patients with myocardial or coronary disease). Therefore, in assessing the dosage and rate of administration, one must bear in mind both the variation in responsiveness of the central nervous system and the sensitivity of the

cardiovascular system, so obtaining adequate depression of the one without prejudicing the efficiency of the other.

Thiopentone is very soluble in neutral fat and is stored in the body fat depots. Metabolism is slow and ultimate removal from the body is prolonged (Brodie and others, 1950, 1952; Shideman and others, 1953). The use of small dosages allows a rapid return to consciousness, but even very low blood-levels affect the psychological state and mental alertness; therefore patients are not fit to go about unaccompanied for many hours following its administration.

Patients may be intubated following the rapid administration of a large dose of thiopentone. The method is dangerous and is not to be recommended. Better conditions are more easily obtained in safety by giving a "sleep dose" of thiopentone (i.e., a small dose given fairly rapidly) followed by a relaxant drug; hypnosis and amnesia are maintained using nitrous oxide and oxygen.

RELAXANT DRUGS

For out-patient use, relaxant drugs must be either short-acting or readily and completely reversed to allow early ambulation. They are normally classified as follows:—

1. Antidepolarizing drugs (tubocurarine and gallamine). These act at the endplate by competitive inhibition of acetylcholine. Their action is of a relatively long duration. The block may be reversed by increasing the endplate acetylcholine concentration (anticholinesterase drugs), or by increasing the sensitivity of the endplate to acetylcholine (edrophonium); neostigmine combines both properties and is the drug normally used in anæsthetic practice—it is preceded by atropine to prevent its muscarinic cholinergic effects.

Gallamine ("Flaxedil") is a typical antidepolarizing drug, and is readily reversed by neostigmine. It was found, using a small dosage (e.g., 60 mg. in a normal adult), that relaxation was sometimes poor and intubation difficult. After administration of neostigmine (2·5 mg. preceded by atropine $\frac{1}{50}$ gr.) respiration rapidly returned to normal; however, even using smaller doses of gallamine (40 mg. in a normal adult), neuromuscular recovery was not adequate for the more exacting task of locomotion, patients feeling weak for many minutes post-operatively. It is therefore not considered suitable for use in out-patients.

2. Depolarizing drugs (succinylcholine, decamethonium). These produce a state of depolarization at the endplate, with a spread to the adjacent part of the muscle fibre. There is no antidote to the state of depolarization; recovery of the endplate occurs following removal of the drug by metabolism (hydrolysis) or excretion.

Following prolonged administration or repeated doses, the endplate may develop a tolerance to depolarizing drugs, including acetylcholine. This is a state equivalent to that found using an antidepolarizing drug, i.e., a "mixed block" is produced. If an antidepolarizing drug is given before a depolarizing one, the latter tends to lose some of its depolarizing characteristics and acquire antidepolarizing ones. When acting in an antidepolarizing capacity, depolarizing drugs may be reversed by neostigmine or edrophonium, though if there is any persistent depolarizing action the block will be accentuated. Succinylcholine chloride ("Scoline") is a typical short-acting depolarizing drug. The onset of action is rapid and normally it is rapidly hydrolysed by plasma-cholinesterase (pseudocholinesterase) to give a short duration of action. Using an intermittent dosage technique it is easy to intubate the patient and pack the pharynx effectively, but it is difficult to maintain a constant degree of relaxation. After each dose the patient becomes apnœic and respiration must be manually controlled (giving a slight but noticeable increase in bleeding). Once respiration becomes adequate in the lightly anæsthetized patient, he very soon starts to swallow, "buck" and "gag", etc., so disturbing the pack and increasing the bleeding, in addition to hindering surgery. A 0·1 per cent succinylcholine drip gives continuous control of relaxation, allowing the maintenance of adequate respiration combined with a uniform degree of relaxation.

It has been stated (Paton, 1953) that the administration of succinylcholine by intra-

venous drip increases the requirements of the drug. Large doses may produce powerful muscarinic cholinergic effects (e.g., excessive salivation or hypotension, the latter possibly accentuated by histamine release). Although these effects may be prevented by atropine premedication (Johnstone, 1955), sympathetic ganglion stimulation may cause a rise in blood-pressure. The use of a succinylcholine drip is also said to predispose to prolonged relaxation. This may be due to the development of a "dual action" or a "mixed block" produced by succinylcholine (Paton, 1956; Brennan, 1956) or to the accumulation of breakdown products (succinylmonocholine or choline) which in large amounts have relaxant effects (Whittaker and Wijesundera, 1952; Paton, 1953). Prolonged relaxation may also be seen in debilitated patients who have a low plasma-cholinesterase level and hence are unable to rapidly hydrolyse the drug (Hodges and Harkness, 1954). If an excess of carbon dioxide is allowed to accumulate, it too will have a respiratory depressant effect.

However, if adequate spontaneous respiration is maintained during anæsthesia, it is found that the amount of succinylcholine used is lower than would be expected using an intermittent dosage technique (and rarely exceeds 100 mg. in cases of less than half an hour's duration). One would not therefore expect to see any ill effects due to large dosage. A further advantage of maintaining spontaneous respiration is that the susceptibility of the patient to the relaxant effects of the drug is continuously in evidence. This renders highly unlikely any post-operative respiratory depression or prolonged relaxation.

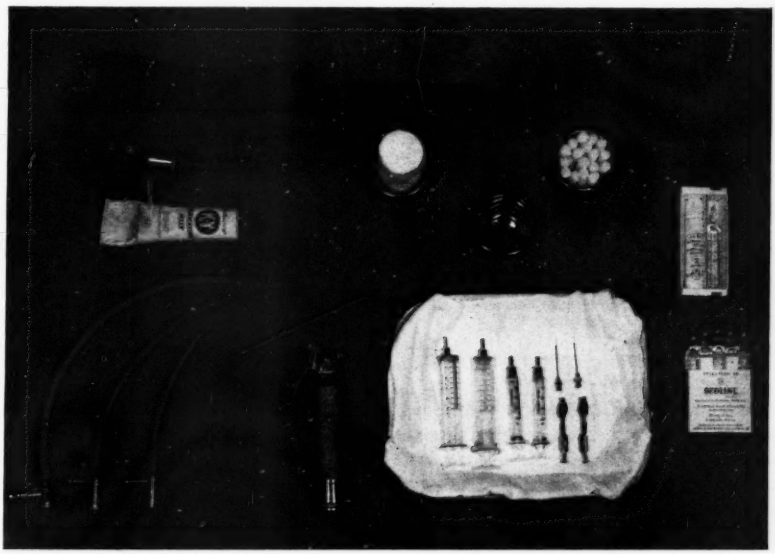

Fig. 1.—The apparatus normally used for endotracheal anæsthesia in the dental chair.

If there were to be any post-operative respiratory depression, the possibility of the narcotic effects of excessive CO_2 retention should first be eliminated by a period of hyperventilation using a large flow-rate of gases, or a soda-lime absorber. This not being effective, one should suspect the drug has acquired an antidepolarizing action—this is ascertained by giving a test dose of edrophonium (10 mg.) which is rapidly hydrolysed and has therefore only a temporary effect. If the respiration is improved, neostigmine should be given (in 0·5 mg. doses up to a total of 5 mg., preceded by atropine $\frac{1}{50}$ gr.). Sometimes the

transfusion of a small amount (250–500 ml.) of fresh blood may remedy the situation (Evans, Gray, Lehman, and Silk, 1952).

DETAILS OF EQUIPMENT AND TECHNIQUE OF ADMINISTRATION

Drugs and apparatus, etc., are prepared prior to the patient's arrival at the dental chair. This avoids inducing a state of anxious bewilderment in the patient and helps to give a smooth unimpeded progress of anæsthesia.

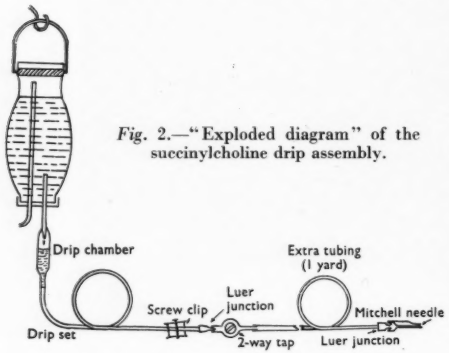

Fig. 2.—"Exploded diagram" of the succinylcholine drip assembly.

On a tray are placed: a laryngoscope; a selection of lubricated nasotracheal tubes (sizes 5, 6, and 7, Magill) with connexions; glycerin-lubricated sterile throat packs, and Magill forceps. The syringes, ampoules, drugs, etc., are kept separately—it being useful to have $\frac{1}{4}$ g. thiopentone ready drawn up in a syringe (*Fig.* 1).

The succinylcholine drip is prepared as follows: Using the 100 ml. graduations on a 500 ml. bottle of normal saline or 5 per cent glucose, succinylcholine chloride is added to give the required volume of 0·1 per cent solution (100 mg./100 ml.). The amount used for each patient is easily estimated using the graduations on the bottle (usually 50–100 ml. for operations lasting up to 20 min.). For a single case, a thiopentone stock bottle (100 c.c. capacity) may easily be adapted for use with the later type of Blood Transfusion Service giving-set.

The needle (with the adjacent few inches of tubing) is disconnected from the giving-set at the Luer junction, and is replaced by a tap. A sterile piece of tubing has connexions at one end to fit this tap and at the other to fit a Mitchell's needle inserted in the patient's vein. To avoid using a fresh sterile giving-set for each patient, this piece of tubing is removed and replaced by a similar piece; it is flushed through with the succinylcholine solution to avoid air embolism. To give gravity feed to the patient, the bottle is hung from a drip stand, or it may be attached to some projection from the dental unit such as the spotlight or engine arm (*Figs.* 2, 3).

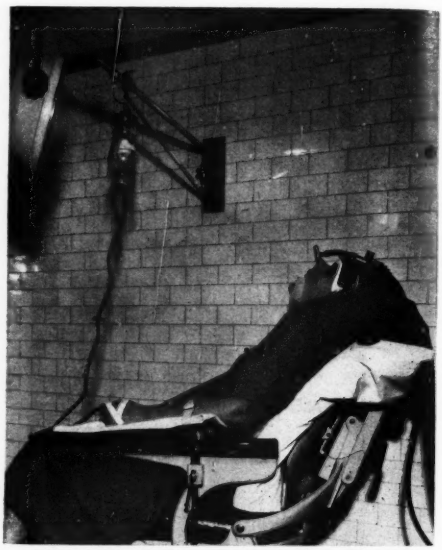

Fig. 3.—The patient anæsthetized, positioned in the dental chair, with the left arm on the arm-board and the drip bottle hanging from the lamp bracket. Note the small pillows giving support to the neck and lumbar spine.

An arm-board attachment to the left-hand arm-rest of the dental chair is useful in order to position the arm satisfactorily and keep it immobilized throughout the operation (*Figs.* 4, 5).

The patient is instructed not to have food or drink during the six hours prior to anæsthesia. Whilst seated (either in dental chair or in an ante-room) a Mitchell's needle is inserted into a vein in the dorsum of the hand or forearm. Through this a premedicant dose of $\frac{1}{100}$ gr. atropine is given. The patient is

positioned in the dental chair to facilitate intubation. The chair is placed almost horizontal; the cervical spine is maintained in the position normally seen in the erect posture, and the head slightly extended on the atlas to bring the mandible at right angles to the slope of the chair, i.e., "the relative position of a man scenting the air" (Magill, 1930).

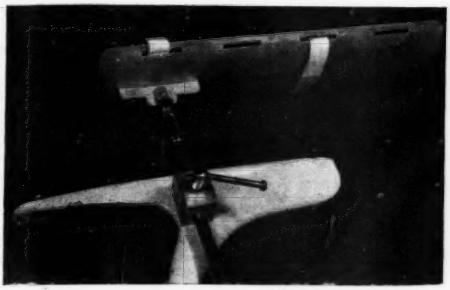

Fig. 4.—The arm-board attachment, with fittings to the left-hand arm-rest of the dental chair.

Care must be taken to prevent excessive head-movement when the patient is relaxed, so giving rise to a stiff neck post-operatively. If there is a large gap between headrest and backrest in the chair, it is worth while inserting a pillow to give adequate support to the neck. The arm, with indwelling needle, is fastened to the arm-rest to avoid displacement of the needle, should the arm tend to move.

Anæsthesia is induced by a fairly rapid injection (via Mitchell's needle) of 0·15–0·25 g. thiopentone. The succinylcholine drip is immediately connected to the Mitchell needle and allowed to flow at a rapid rate (150 drops/min.) until relaxation is complete, when it is temporarily clipped off a couple of inches from the needle to avoid reflux of blood to the tubing.

During the onset of relaxation, nitrous oxide and oxygen (80 per cent : 20 per cent) is administered by face-mask, and respiration is manually controlled by bag pressure. When relaxation is adequate a lubricated naso-tracheal tube (of appropriate size) is inserted. This may frequently be passed "blind"; otherwise it is inserted using a Macintosh laryngoscope and Magill's forceps. It is connected to the anæsthetic machine using the largest possible connexions to avoid undue airway resistance, and is held in place by a Hudson harness. An efficient gauze pad is inserted, this being lubricated with glycerin to minimize trauma and scarification of the palate and pharynx.

Anæsthesia is now continued, using nitrous oxide and oxygen (90 per cent : 10 per cent)

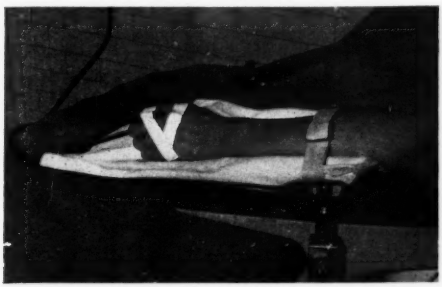

Fig. 5.—Close-up view of the patient's arm strapped to the padded arm-board. Immobilization of the arm prevents disturbance of the drip, should the patient attempt to move the arm.

at a high flow-rate (we use a McKesson apparatus with reservoir bag attachment. A 10-mm. pressure setting gives a good flow-rate whilst using the reservoir bag for controlled respiration. During spontaneous respiration the bag may be cut out of circuit and a low-pressure intermittent-flow technique used). As anæsthesia progresses the percentage of oxygen is gradually increased (especially so in older people).

As spontaneous respiration returns, the clip is removed from the drip tubing to allow the succinylcholine solution to flow. The rate is regulated by a gate clip to give good respiratory excursions yet allow adequate relaxation of the jaw for the performance of intra-oral surgery. At this stage the chair is positioned to suit the operator and surgery commenced.

When the operation is completed the drip is discontinued. The patient is given 100 per cent oxygen to breathe for a few breaths, whilst the oral cavity is sucked clear of blood, mucus, and foreign matter. The pack is removed—this usually stimulates the patient to open the mouth widely or to attempt to remove his own tube. The endotracheal tube is now removed.

With patients so nearly conscious, laryngeal spasm is virtually absent, but must be anticipated, the face-mask being replaced ready to administer oxygen under pressure if required. The patient is sat forward and spits any further blood into a receptacle held under the chin.

DISCUSSION

The method described appears to be somewhat elaborate, but is essentially simple, only requiring greater preparation before anæsthesia than is necessary for other techniques. This technique is not intended to be used for simple extractions or minor procedures in the anterior oral cavity. It is, however, well worth while spending a few minutes in preparation for the more difficult surgery, especially of the posterior oral cavity. Not only may these minutes be saved later, but the smoothness of anæsthesia and relaxation allow careful, detailed surgery which cannot be performed under the conditions of anoxia, straining, and jaw movement which so frequently give rise to a "smash and grab" operation. These conditions cannot be rivalled by any technique which does not necessitate admission to hospital—so taking up a valuable bed.

The complications ascribed to the use of a succinylcholine drip have not been seen in our series of 52 cases, presumably due to the low dosage required. Motor power rapidly returned to normal in all our patients, so allowing early ambulation (usually within one or two minutes of the cessation of anæsthesia). In several cases blood-pressure readings were taken before, during, and after anæsthesia and no significant changes were found.

The described technique gives the following advantages:—

1. Smoothness of anæsthesia—the controlled degree of relaxation obtained using a succinylcholine drip allows one to achieve smoothness in the lightest planes of anæsthesia. This condition is not fulfilled using an intermittent dosage technique, where the degree of relaxation is constantly varying.

2. Ease of surgery—controlled relaxation of the jaw allows easy access to the mouth without the necessity for gags and props, etc. It has been suggested that the use of relaxant drugs gives a greater tendency to temporo-mandibular joint dysfunction post-operatively. This has certainly not been a feature in our series, where care has been taken to avoid excessive depression of the mandible.

3. Bleeding is minimal.

a. Respiration is adequate, regular, and spontaneous; the resultant normal intra-thoracic pressure changes help to reduce venous congestion and oozing.

b. There is no venous engorgement due to straining or gagging, as found in most methods using very light planes of anæsthesia.

c. Adequate respiration prevents any undue build-up of carbon dioxide, with its consequent increase in bleeding.

d. Adoption of a sitting position decreases any venous congestion in the head and neck.

e. A normal blood-pressure avoids increased arterial bleeding.

f. Adrenaline (1 : 100,000) or procaine and adrenaline may be injected locally to produce active vasoconstriction.

4. Relaxation is limited to the period of operation, so allowing early ambulation. As stated above, the patient is able to walk (with only slight assistance) from the chair within two minutes of stopping anæsthesia.

5. Recovery is rapid. The use of a small induction dose of thiopentone, avoidance of other prolonged depressant drugs, and the absence of anoxia are all made possible by this method of "controlled relaxation".

6. Post-operative sequelæ are minimized:—

a. If respiration is adequate during surgery, one is never left in the dilemma of the post-operative apnœic patient—as one may be using multiple intermittent injections of succinylcholine, especially if the procedure turns out to be more prolonged than was anticipated.

b. Vomiting is minimal—due to the avoidance of potent analgesics in ambulant patients, the absence of anoxic episodes, and the smoothness of anæsthesia. In our series (52 cases) only 16 per cent had any post-operative nausea or vomiting.

c. Muscle and joint pains appear to be somewhat reduced as compared with previously published figures.

Following the use of succinylcholine chloride, a proportion of patients develop skeletal pain of varying severity; some cases are incapacitated and require bed rest and analgesics. The onset of pain is usually on the first post-operative day but may be on the second. Churchill-Davidson (1954) showed a low incidence of pain in patients confined to bed for 48 hours after operation, but a high incidence in out-patients or patients who are allowed up. Thus in out-patients (32 cases) he found the incidence of post-operative pain to be 66 per cent (severe in 44 per cent, moderate in 6 per cent, and mild in 16 per cent), whereas in in-patients (36 cases) the incidence was only 14 per cent (severe in 3 per cent and mild in 11 per cent).

Morris and Dunn (1957) using a single-dose technique in a larger out-patient series (73 cases) found a similar pain incidence (72 per cent, of which 22 per cent were severe). In another series (27 cases) they showed that by slowing the rate of injection to 20 mg. per minute, muscle fasciculations were almost abolished, but there was no significant effect upon the post-operative pain incidence (74 per cent, of which 30 per cent were severe). It was shown (in a series of 65 cases) that the previous administration of a small dose of an antidepolarizing drug (*d*-tubocurarine chloride 5 mg. or gallamine 40 mg.) effectively reduces the incidence and severity of the pain (22 per cent, of which only 5 per cent were severe). However, in view of the unexpected, atypical, and unpredictable results of the combination of depolarizing and antidepolarizing relaxants, the diminution in the incidence of post-operative muscle pain does not justify this practice (Hodges, 1957). Not only that, but the administration of 40 mg. gallamine alone gives post-operative weakness, and it would be expected that this combination of relaxants would produce an even greater weakness.

In our series (52 cases) the incidence of pain was 61 per cent, of which 38 per cent showed only slight discomfort which disappeared whilst returning home. This must be compared with the small series (20 cases) using gallamine, in which the post-operative pain incidence was 20 per cent. Our apparently low incidence of post-operative pain may be related to the administration of succinylcholine by intravenous drip, or more probably it is due to the careful positioning and support of patients to avoid the overstretching of ligaments and partly paralysed muscles.

It would appear, therefore, that the administration of succinylcholine by intravenous infusion does not add greatly to the post-operative discomfort of the patient and that any disadvantage in this respect is greatly outweighed by the advantages of controlled relaxation produced by this method.

SUMMARY

1. A method of endotracheal anæsthesia for use on the ambulatory patient in the dental chair is described.

2. The good operating conditions produced allow greater scope for oral surgery in the dental chair due to controlled relaxation and minimal bleeding.

3. The rapid recovery from this form of anæsthesia simplifies post-operative supervision of the patient, patients being fully co-operative and ambulant within a few minutes of the termination of surgery. In hospital practice this gives a great saving of beds.

4. The after-effects of anæsthesia appear to be minimal using this technique.

REFERENCES

BRENNAN, H. J. (1956), *Brit. J. Anæsth.*, **28**, 159.
BRODIE, B. B. (1952), *Fed. Proc.*, **11**, 632.
— — BERNSTEIN, E., and MARK, L. C. (1952), *J. Pharmacol.*, **105**, 421.
— — MARK, L. C., PAPPER, E. M., LIEF, P. A., BERNSTEIN, E., and ROVENSTINE, E. A. (1950), *Ibid.*, **98**, 85.
CHURCHILL-DAVIDSON, H. C. (1954), *Brit. med. J.*, **1**, 74.
DUNDEE, J. W. (1956 a), *Thiopentone and other Barbiturates*. Edinburgh: E. & S. Livingstone.
— — (1956 b), *Brit. J. Anæsth.*, **28**, 344.
EVANS, R. T., GRAY, P. W. S., LEHMAN, H., and SILK, E. (1952), *Lancet*, **1**, 1229.
HODGES, R. J. H. (1957), *Brit. med. J.*, **1**, 648.
— — and HARKNESS, J. (1954), *Ibid.*, **2**, 18.
JOHNSTONE, M. (1955), *Anæsthesia*, **10**, 122.
MAGILL, I. W. (1930), *Brit. med. J.*, **2**, 817.
MORRIS, D. D. B., and DUNN, C. H. (1957), *Ibid.*, **1**, 383.
PATON, W. D. M. (1953), *Anæsthesia*, **8**, 151.
— — (1956), *Brit. J. Anæsth.*, **28**, 470.
SHIDEMAN, F. E., GOULD, T. C., WINTERS, W. D., PETERSON, R. C., and WILNER, W. K. (1953), *J. Pharmacol.*, **107**, 368.
WHITTAKER, V. P., and WIJESUNDERA, S. (1952), *Biochem. J.*, **52**, 475.

BRITISH SOCIETY OF PERIODONTOLOGY

ANNUAL CLINICAL MEETING, 1958

Held at the Eastman Dental Hospital, London, on May 16, 1958

CASES OF CLINICAL INTEREST

By **J. R. TROTT,** B.D.S.
*Department of Periodontology, Institute of Dental Surgery, London, W.C.*1

Case 1.—GINGIVECTOMY

ACUTE ulcerative gingivitis characteristically destroys the interdental papillæ so that a crater is formed interdentally. The acute phase of the disease can be treated by a variety of means, but unless a satisfactory gingival contour is produced, when the acute phase has passed, then re-infection is bound to occur with a further loss of interdental tissue. *Fig.* 1 shows such a case where the acute attack has been treated by chromic acid, followed by zinc oxide and oil of cloves packing. Over the previous four months there had been a series of recurrent attacks. It will be noticed that there has been a significant amount of interdental destruction and the only way to establish a satisfactory gingival contour is by performing a gingivectomy.

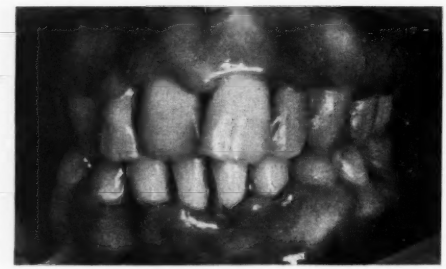

Fig. 1.—Marked interdental cratering and an unsatisfactory gingival contour are demonstrated in this anterior view of an unsuccessfully treated case of Vincent's disease.

Fig. 2.—Same case as *Fig.* 1 three months later, showing the satisfactory gingival contour produced by gingivectomy.

Fig. 2 shows that a new gingival contour has been established and it is now possible for the patient to maintain satisfactory oral hygiene.

Case 2.—GINGIVECTOMY AND DENTURE SPLINT

This is another case of an acute ulcerative gingivitis which has been inadequately treated. Due to the frequency of the recurrent attacks the dentist extracted all the mandibular teeth except $\overline{43|34}$ and inserted an acrylic partial lower denture (*Fig.* 3). When the patient was first seen there was a periodontal abscess distal to $\overline{4|}$ and a recurrent acute ulcerative gingivitis around the maxillary teeth. The acute phase was controlled by penicillin chewing-gum and the abscess was drained by an incision. A gingivectomy was performed around the maxillary teeth and in the $\overline{43|}$

Fig. 3.—On the right a very unsatisfactory acrylic partial denture that has been worn for some years. On the left, the new partial denture incorporating a cast splint. Notice the degree of tissue coverage that has been obtained to stabilize the denture.

region. The teeth were then prepared for a partial lower denture. The occlusal surfaces of the maxillary teeth were ground to establish a satisfactory occlusal plane, whilst the interproximal and lingual surfaces of $\overline{43|34}$ were ground to reduce the undercut area so that a maximum amount of denture would be against the tooth and would aid in splinting the mobile teeth. A partial lower denture was constructed so that it covered the maximum mucosal surface and also incorporated a cast splint for the $\overline{43|34}$ (*Figs.* 3, 4). This case illustrates the need for early radical treatment in the establishment of a satisfactory gingival contour and the necessity of constructing a suitable partial denture with a splint incorporated.

Fig. 4.—Post-operative result of a case similar to *Fig.* 1, showing a satisfactory gingival contour and the partial lower splint denture in place.

Cases 3 and 4.—SULCUS DEEPENING

The need for deepening the sulcus has received a certain amount of attention in the recent periodontal literature. Two cases were presented where this had been performed successfully. A vertical incision is made at either end of the area where the sulcus needs to be deepened. The incisions extend from the gingival margin well into the mucobuccal fold. The interdental papillæ are incised and a mucoperiosteal flap is retracted so that the soft tissue in the pockets and the bone is well exposed. Curettage of the soft tissue in the interdental areas is then performed, followed by a smoothing and contouring of the labial bone. The gingival margin of the flap is then trimmed with scissors and replaced so that the margin lies on the bone apical to the junction of the bone to the tooth. A normal gingivectomy is then carried out on the lingual aspect and a gingivectomy pack placed firmly in position. The pack is replaced one week later by another which is left in place for a further week. This is then removed and oral hygiene instituted with a soft toothbrush and interdental wood points. *Fig.* 5 shows the satisfactory healing that takes place following such an operation in the right mandibular molar area.

Fig. 5.—Sulcus deepening was performed on the buccal aspect of the right mandibular region, extending from $\overline{4}|$ to $\overline{7}|$.

Case 5.—TWO-PART SPLINT

Due to a history of epilepsy a normal partial denture or removable splint was considered unsatisfactory. A fixed splint was considered, but the number of teeth involved would have

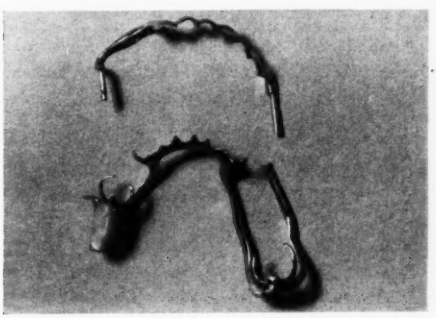

Fig. 6.—Two-part splint. The lingual portion which is inserted first is in the lower part of the illustration. The labial bar in the upper part of the illustration slides into the tube extension on the right and is locked with a pin on the left.

made this extremely difficult and impracticable. A two-part cast splint was designed and constructed and has proved satisfactory so far, although the patient has not had an epileptic episode since its construction.

The design is based upon a double path of insertion. The lingual portion is inserted first and then the labial bar slides into a tube on a buccal extension from the lingual bar and is locked with a pin (*Fig.* 6).

TABLE DEMONSTRATIONS

SOME CASES OF FAMILIAL WHITE-FOLDED GINGIVO-STOMATOSIS

By **J. P. FLETCHER**, B.D.S., F.D.S. R.C.S.
University of Liverpool

Four cases were demonstrated by means of black-and-white photographs, colour transparencies, and microscope slides. These cases occurred in two generations of the same family.

The clinical conditions and variations and the differential diagnosis were discussed, and the histological picture described. It was stated that the histology of the condition of the epithelial layers was difficult to explain (Darling and Fletcher, 1958).

The demonstration emphasized that the main importance of the condition was in its recognition and differentiation from the other white lesions which could affect the oral mucosa, some of which might require urgent treatment. It was considered that the only treatment necessary for familial white-folded gingivo-stomatosis was reassurance of the patient that the condition was harmless.

REFERENCE

DARLING, A. I., and FLETCHER, J. P. (1958), *Oral Surg.*, **11**, 296.

INVASION OF THE PERIODONTAL MEMBRANE BY NEOPLASMS

By **J. P. WATERHOUSE**, B.D.S., M.B., B.S.

The involvement of the elements of the periodontal membrane by neoplasms was illustrated by photomicrographs and microscope slides. The neoplasms were: A benign locally infiltrating epithelial neoplasm, a pleomorphic salivary adenoma, three squamous carcinomas, a chondrosarcoma, and a secondary neuroblastoma.

In most cases the new growths approached the periodontal membrane from the medullary spaces of the jaw bone, and, therefore, the bone lining the tooth socket was the first periodontal element to be affected. Resorption of this bone was followed by the disappearance of functionally orientated periodontal membrane fibres. Subsequently resorption of root cementum, and sometimes of dentine, occurred. In areas where tumour masses lay adjacent to both bone and cementum, cementum appeared more resistant to resorption than bone. This agrees with the views of Kronfeld (1938).

In the present small sample there was little evidence that root repair alternated with root resorption, as stated by Boyle (1955), though some cementum deposition had probably occurred in relation to the slow growth of the benign epithelial neoplasm.

Throughout this material, which was comprised mainly of malignant growths, resorption of hard tissues and loss of functional soft tissues predominated. Bone was apparently lost more rapidly than cementum. There was little evidence of a repair mechanism.

REFERENCES

KRONFELD, R. (1938), *J. Amer. dent. Ass.*, **25**, 1451.
BOYLE, P. E. (1955), *Kronfeld's Histopathology of the Teeth*, p. 286. London: Kimpton.

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THE MICROHARDNESS OF ROOTS OF TEETH WITH PERIODONTAL DISEASE*

By R. D. EMSLIE, M.S. (Ill.), B.D.S., F.D.S.
Guy's Hospital Dental School, London
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IT has been reported (Riffle, 1951, 1954) that the cervical region of the roots of teeth which have been extracted for periodontal disease can be curetted more readily than the same region of control teeth. There would also appear to be a difference in the ratios of free amino-acid groupings (ninhydrin reacting substances) in the inner and outer cervical dentine of teeth with and without periodontal disease (Emslie and Stack, 1957). If the dentine is easier to cut, one might expect that its microhardness also is reduced, and the present study was planned to discover whether any marked changes in hardness had occurred.

Table I.—MICROHARDNESS NUMBERS OF SILVER-COATED, TRANSVERSE SECTIONS OF THE CERVICAL REGION OF ROOTS OF TEETH

PERIODONTAL DISEASE GROUP					CONTROL GROUP				
Age	*Sex*	*Tooth*	*Microhardness Numbers*	*Mean*	*Age*	*Sex*	*Tooth*	*Microhardness Numbers*	*Mean*
49	M.	$\overline{\lvert 7}$	64·5 61·6 63·2	63·1	30	M.	$\overline{\lvert 3}$	69·1 68·6 71·0	69·6
49	M.	$\underline{\lvert 7}$	65·05 63·9	64·5	46	M.	$\underline{1\rvert}$	69·9 69·1 72·4	70·5
34	M.	$\underline{6\rvert}$	62·6 67·5 62·7	64·3	38	F.	$\underline{3\rvert}$	71·6 71·6	71·1
32	F.	$\underline{3\rvert}$	71·3 71·3	71·3	17	M.	$\overline{5\rvert}$	68·85 74·5 70·2	71·2
31	M.	$\underline{6\rvert}$	64·1 69·1 73·6	68·9	17	M.	$\underline{4\rvert}$	65·0 64·1 72·15 72·4	68·4
46	F.	$\underline{\lvert 5}$	63·6 66·7	65·2	38	F.	$\underline{\lvert 7}$	70·2 66·5 71·0	69·2
54	M.	$\underline{\lvert 2}$	66·5 72·7 66·7	68·6	31	F.	$\overline{\lvert 8}$	79·2 74·5 74·5	76·1
22	F.	$\overline{\lvert 7}$	69·1 72·4 70·7	69·6	47	M.	$\overline{6\rvert}$	69·1 73·9 71·9 71·9	71·7
Average 39·6				67·1	33				70·9

* Given at the Annual Clinical Meeting of the British Society of Periodontology held on May 16, 1958.

METHOD AND MATERIALS

Some of the teeth from the "periodontal" and "control" groups used in the previous study (Emslie and Stack, 1957) had been preserved in 1 per cent zephiran chloride. Sections

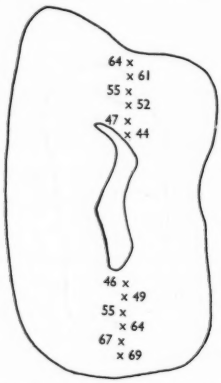

Fig. 1.—Diagram showing the position of pyramidal indentations in a section of the cervical region of an upper molar tooth. The calculated microhardness numbers for each indentation are recorded.

approximately 1 mm. thick were cut with a fretsaw from the cervical region of 8 roots from each group, and coated with silver *in vacuo* before taking microhardness readings. The impressions of the diamond pyramid under constant load were made approximately half-way between the outer and the pulpal edges.

Similar sections from another collection of 9 "periodontal" and 9 "control" teeth were cut with a 150-grade carborundum disk, ground on a Belgian stone, and polished. They were then mounted on blocks of dental plaster and set on microscope slides before drying overnight. These specimens were examined with a G.K.N. Microhardness Tester.* The diamond pyramidal indenter was mounted in a microscope of the requisite precision. The stage was advanced in steps of 0·2–0·4 mm. from the outer edge to the pulpal boundary and frequently across to the further side again (*Fig.* 1). Pyramidal indentations with square bases, 45–50 μ across, were made under constant load (100 g.). Diamond pyramid hardness numbers were calculated from tables based on averages of diagonal measurements.

RESULTS

Microhardness calculations for the silvered sections are shown in *Table I.* The mean microhardness number for the periodontal group is 67·1 and for the control group 70·9; the difference between the groups is statistically significant ($P<0·001$).

Calculations for the polished sections are shown in *Table II.* The means for outer and inner dentine of the periodontal group are 71·75 and 49·6, and of the control group 75·4 and 63·2 respectively. Chauvenet's criterion

Table II.—Microhardness Numbers of Inner and Outer Zones of Transverse Sections of the Cervical Region of Roots of Teeth

Periodontal Disease Group					Control Group				
Age	*Sex*	*Tooth*	*Microhardness Number*		*Age*	*Sex*	*Tooth*	*Microhardness Number*	
			Inner	Outer				Inner	Outer
24	F.	6	39	99	22	F.	6	45	67
30	F.	7	63	68	33	M.	7	61	76
31	M.	6	44	84	34	F.	8	70	84
32	M.	3	43	75	36	M.	5	45	73
37	M.	1	56	67	36	F.	6	82	74
37	F.	?	40	68	41	F.	8	69	84
37	M.	7	74	84	42	M.	4	71	82
44	F.	6	46	63	?	M.	3	46	71
49	F.	5	41	65	?	M.	6	40	68
Average 36			50	72		35		63	75

* Associated Automation Ltd., 70 Dudden Hill Lane, London, N.W.10.

was applied to eliminate the reading "99" in the periodontal group. Values for the outer dentine do not appear to differ significantly ($0{\cdot}3<P<0{\cdot}4$), but the difference for the inner dentine is highly significant ($P \ll 0{\cdot}001$).

DISCUSSION

From these results it would appear that the dentine of the cervical region of the roots of teeth is softer when they have been surrounded by periodontal pockets. However, the reduction in microhardness is greater in the inner than the outer dentine.

The microhardness readings for dentine are not necessarily directly related to the ease with which it can be curetted. Scratch tests may provide a more valid comparison.

Acknowledgements.—We are indebted to Mr. R. J. Durham of the Aluminium Laboratories, Ltd., Banbury, for the silver coating and microhardness testing recorded in *Table I*, and to Mr. A. C. Kerr for the statistical analyses.

REFERENCES

EMSLIE, R. D., and STACK, M. V. (1957), *Dent. Practit.*, **8**, 19.

RIFFLE, A. B. (1951), *J. Periodont.*, **22**, 225.

— — (1954), *Ibid.*, **25**, 138.

BOOK REVIEWS

DENTAL CLINICS OF NORTH AMERICA: Symposium on The Interrelationship of Oral and Systemic Disease. Ed. LESTER W. BURKET, D.D.S., M.D. Pp. 543, with 59 illustrations and 18 tables. Philadelphia and London: W. B. Saunders Co. 98s. for a year's subscription to three numbers.

THIS symposium on "The Interrelationship of Oral and Systemic Disease" is part of a series appearing under the title *Dental Clinics of North America*. Although it is in reality a subscription journal, for three consecutive numbers have to be ordered, each issue is produced in book form, and very handsomely produced, too.

The present reviewer, in his review of the July, 1957, symposium on "Emergencies in Dental Practice", wrote: "If the companion volumes in this series are of the same high standard, they will be a valuable addition to the dental literature suited to daily practice". This, July, 1958, volume, now under review, has more than lived up to these hopes, for under the able editorship of Dr. L. W. Burket we have in this collection of articles on dental medicine by leading authorities the ideal book for the busy practitioner interested in looking beyond the teeth and the periodontal membrane.

The information is presented in an interesting manner, in good print on high-quality paper. While the illustrations are of a high standard, there are perhaps not enough of them for a subject that lends itself so well to good illustrations. This is a good book and well worth reading. B. E. D. C.

CLINICAL PERIODONTOLOGY. The Periodontium in Health and Disease. Recognition, Diagnosis, and Treatment of Periodontal Disease in the Practice of General Dentistry. By IRVING GLICKMAN, B.S., D.M.D., F.A.C.D., Professor of Oral Pathology and Periodontology and Director of the Division of Graduate and Postgraduate Studies, Tufts University School of Dental Medicine. Second edition. $10\frac{1}{4} \times 6\frac{3}{8}$ in. Pp. 978 + xvii, with 720 illustrations. 1958. Philadelphia and London: W. B. Saunders Co. 122s. 6d.

THE first edition of this work appeared in 1953; in the second edition the text has been revised and brought up to date and the author has succeeded in shortening it by some forty pages. This is commendable, for a text-book of this size and price is likely to be beyond the reach of many students and general practitioners. The text has been altered in respect of the sections of treatment, being divided into 5 parts:—

1. Diagnosis, Prognosis, and Treatment Planning.

2. Soft Tissue Phase—The Elimination of Inflammation and Pockets and Causes.

3. Functional Phase—The Establishment of an Optimum Functional Relationship for the Entire Occlusion.
4. Systemic Phase.
5. Maintenance Phase.

This seems a very reasonable method of dealing with treatment and is an improvement on the layout used in the first edition. In the section on Aetiology of Periodontal Disease, in the table of contents the role of traumatic occlusion is now termed, "The Role of Trauma from Occlusion", thus falling in line with the change in outlook concerning this factor which has been taking place over recent years.

With regard to the chapter on instruments, the explorers shown are of the type normally used in the detection of caries, and are not ideally suited for the location and detection of small amounts of deep-lying subgingival calculus. Concerning the gingivectomy knives, the Monahan-Lewis adjustable knife, with its blade which does not hold a keen edge, is mentioned, whereas the Blake gingivectomy knife utilizing the expendable blades of the Bard-Parker type is not. The work of Orban, Waerhaug, and others concerning instrument size in relation to pocket dimensions has been referred to, but many of the instruments shown, particularly the hoes, greatly exceed the optimal dimensions. The need for sharp instruments is stressed, and the technique of sharpening is clearly brought out, but no mention has been made of tungsten bladed instruments which more or less eliminate the need for sharpening.

Included for the first time, under the heading "Other Techniques for Eradicating the Periodontal Pocket", is a technique for using bone implants and a sliding flap technique for the repair of gingival defects. The book is well illustrated, the great majority of the photographs being excellent. One photograph (page 158) was noted to be upside down, and the colour illustrations on page 526 would not appear to be of sufficiently high quality to justify their inclusion. In the revised copy, page 309 is inserted out of order, following page 306. It is a pity that the cost of this book has risen from £3 15s. 0d. to £6 2s. 6d. Nevertheless, the last paragraph of the review of the first edition in this JOURNAL may be quoted: "The reviewer has no hesitation in recommending this work without reserve to every member of the dental profession as well as to undergraduate students, whilst medical practitioners and specialists would also profit greatly from perusal of its contents"—with which expression of opinion the reviewer of this second edition is in entire agreement.

W. G. C.

PATHOLOGY FOR STUDENTS OF DENTISTRY. By GEORGE L. MONTGOMERY, T.D., M.D., Ph.D., F.R.S.E., F.R.F.D.S. (G.), F.R.C.D.E., Professor of Pathology, University of Edinburgh. Second edition, $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 307 + viii, with 134 illustrations. 1958. Edinburgh and London: E. and S. Livingstone Ltd. 40s.

THE favourable reception accorded to the first publication, five years ago, of Professor Montgomery's attractive and compendious text-book has clearly justified the appearance of a second edition. In the present volume the high standard of presentation has been maintained; that of the illustrations is even improved: some of the darker photographs are lighter, and hence more informative; others have been replaced, and a new augmented set of colour plates substituted. On the whole the text follows closely that of the previous edition save for a few significant changes which reflect the trend of currently accepted views: thus the sections on the pathogenesis of atheroma, the megaloblastic anæmias, and the aetiology of lung carcinoma have been expanded. Similarly, in the chapter on the causation of tumours, the section on radio-activity has been enlarged; in return, that on the virus theory has been pruned, whereas Cohnheim's hypothesis of embryonic cell rests has, justifiably, been relegated to a humbler position within the body of the text. A fuller description of Hodgkin's disease is particularly welcome. In spite of these additions the book's original size has been maintained. Like its predecessor, the present edition seems assured of success. The increase in price is commendably modest in these inflationary times.

L. J. R.

PERIODONTOLOGY: Clinical Pathology and Treatment of Periodontal Tissues. By EDGAR COOLIDGE, B.S., D.D.S., M.S., LL.D., Professor Emeritus of Therapeutics, Preventive Dentistry and Oral Hygiene, Chicago College of Dental Surgery, Loyola University, Chicago, Ill.; and MAYNARD K. HINE, D.D.S., M.S., Professor of Periodontology and Histopathology, and Dean, Indiana University School of Dentistry. Third edition. $9\frac{1}{4} \times 6$ in. Pp. 440, with 268 illustrations and 2 coloured plates. 1958. London: Henry Kimpton. 63s.

ANY book dealing with one aspect of dentistry which has reached a third edition in the space of seven years hardly needs a review. This is particularly true of the book by Coolidge and Hine which really represents more than a third edition, as it is half of the book originally written by Professor Coolidge and divided into two volumes in 1951.

The title sheet bears the phrase "thoroughly revised" and this is, indeed, a fair statement, for much of the book has been re-written and many new and additional illustrations have been included. Another change is in the title, which is now the more widely used "Periodontology" instead of "Periodontia" as in the previous editions, and two new chapters have been written. These chapters deal with nutrition in relation to periodontal disease and halitosis and its treatment. The chapter on nutrition is an excellent one, but very little in the chapter on halitosis is directly concerned with the periodontal tissues and that small amount could profitably have been included in other parts of the book.

One of the great virtues of this book has been that it has been a reasonably small American text-book on periodontology, but this new edition is in danger of becoming large in both volume and price. There is still quite a bit in the text which is not really periodontology and could, therefore, be excluded without the book suffering in any way. Notwithstanding this comment, this book is very probably the most suitable one at the moment for the British undergraduate student and general dental practitioner.

W. B. W.

ABSTRACTS FROM OTHER JOURNALS

Marginal Fit of Direct Acrylic Restorations

The closeness of adaptation between various filling materials and the cavity walls was assessed by observing the penetration of dyes. This was first done at a controlled temperature of 37°C. throughout. Freshly extracted teeth were kept in saline. Cavities were cut as soon as possible and filled. After a further 24 hours in saline at 37°C. the fillings were carved and polished. Each tooth was then arranged, using rubber dam, so that the root was bathed in normal saline whilst the crown was bathed in 2 per cent aniline blue. This continued for 72 hours. The teeth were then ground longitudinally and the penetration of dye was noted.

Amalgam gave satisfactory results, 74 per cent of fillings showing no penetration and 24 per cent showing only slight penetration to enamel depth only. Acrylics gave even better figures of 90 per cent and 10 per cent respectively. Zinc oxide/eugenol and gutta-percha both showed good sealing properties. Oxyphosphate cements and silicates showed marked penetration of the dye.

As acrylics seemed better than clinical experience had indicated and in order to observe the effect of temperature changes, a second series of cavities was cut.

After proceeding as before with aniline blue the teeth were passed from water at 60°C. for 1 min. to 2 per cent Prontosil Rubrum Solubile at 4°C. for 1 min., this being repeated twenty-five times for each tooth. The teeth were then examined for a penetration of red dye where previously there had been no penetration by the blue dye. The results for amalgam were unchanged, but acrylics now showed marked leakage, only 7 per cent now showed no penetration and 18 per cent slight penetration

to enamel depth. Dye penetrated to the floor of the cavity in 60 per cent and completely around the acrylic in 15 per cent of cases.—HIRSCH, L., and WEINREB, M. M. (1958), *J. Amer. dent. Ass.*, **56**, 13.

Reaction of Human Dental Pulp to Cavity Preparation. I. Effect of Water Spray at 20,000 r.p.m.

Patients were selected with non-carious, non-infected vital teeth due to be extracted for periodontal or prosthetic reasons. In selected teeth Class V cavities were cut with an inverted cone diamond stone at 20,000 r.p.m. Variables were reduced to the minimum by one operator cutting all the cavities with the same engine and handpiece. All cavities were cut to the same size and depth as judged by the clinical experience of the operator.

Two techniques were used: Cavities in 27 teeth were prepared with intermittent pressure and no water spray; in 33 teeth continuous air-water spray and uniform pressure were applied. All cavities were air-dried and filled with zinc oxide/eugenol of the same batch. The teeth were removed under L.A. at times ranging from 1 hr. to 36 days.

The teeth were sectioned and examined for pulpal damage. Most sections were stained H. and E., though some were stained P.A.S.

The 1-hr. specimens showed no difference in reactions to the two techniques. Oedematous changes in the odontoblast layer and occasional minute hæmorrhages occurred, but inflammatory cells were not seen.

Teeth extracted 24 hours after the cavity was cut showed marked differences according to technique. Those cut with water spray showed disorganization of the odontoblast layer with infiltrating inflammatory cells and hyperæmia, while hæmorrhages occurred in the deeper layers, but all these reactions were confined to the tissues opposite the cut dentinal tubules. In the " non-spray " specimens there were signs of cellular degeneration, loss of cellular detail, and œdema. These lesions extended beyond the limits of the cut dentinal tubules.

In older specimens " with spray " there was progressive repair, the first secondary dentine appearing after 20 days. None of these specimens showed pulpal abscess, general inflammation, or degeneration. Many " non-spray" teeth showed pulpal abscess or necrosis.

The conclusions were that extensive damage or abscess formation occurred only with the " non-spray " technique and that the potential for recovery was greater using the water spray.—SWERDLOW, H., and others (1958), *J. Amer. dent. Ass.*, **56**, 317.

An Improved Root Canal Cement

Many cements used to fill root canals contain precipitated silver and thus tend to discolour the tooth after a time.

The advantages and disadvantages of common cements used in root canals are discussed and a new cement is recommended which is non-staining. This is based on a powder/liquid cement of the zinc oxide/eugenol type and the formula is given as:

Powder (to pass through 100 mesh sieve)	
Zinc oxide	40 parts
Staybelite resin	30 ,,
Bismuth subcarbonate ..	15 ,,
Barium sulphate	15 ,,
Liquid	
Eugenol	5 parts
Oil of sweet almond	1 ,,

This cement has smooth working properties, plasticity, adhesiveness, and radiopacity. The almond oil retards the initial setting time to about 20 minutes.

Special care in mixing is necessary to prevent a granular rapidly setting cement. Spatulation must be very slow and deliberate, introducing small quantities of powder at a time. Two or three minutes' spatulation is recommended for each drop of liquid used. The cement is ready for use if it does not drip from the spatula during mixing; it offers slight resistance to spatulation; it does not drop off the edge of the spatula in 15 sec. and it will string up for at least 1 in. without breaking.

The cement is soluble in chloroform and when used with gutta-percha points the entire

root filling can readily be removed from the canal at a later date with this solvent. It also dissolves in carbon tetrachloride, xylene, and ether.

The cement is claimed to be non-irritating to the periapical tissues.—GROSSMAN, L. I. (1958), *J. Amer. dent. Ass.*, **56**, 381.

The Effect of a Single Topical Application of Stannous Fluoride on the Incidence of Dental Caries in Adults

One year after a single topical application of 10 per cent stannous fluoride solution to a group of adults there was 24 per cent less dental caries evaluated by the D.M.F.T. and 16 per cent less by the D.M.F.S. indices respectively, compared to a similar group receiving a single topical application of distilled water.—MUHLER, JOSEPH C. (1958), *J. dent. Res.*, **37**, 415.

An Analysis of Stresses in a Dental Amalgam Restoration

The stresses occurring in a disto-occlusal amalgam filling in a primary mandibular first molar were analysed and the following conclusions drawn:—

1. Failure at the isthmus is due to tensile stresses in this region.
2. Tensile stress is at a maximum at the occlusal surfaces.
3. Carved development grooves, rough surface texture, or scratches cause harmful stress concentrations.
4. The stress increases with the distance from the axial wall. The isthmus should therefore be as near this wall as possible.
5. Tensile stress is reduced with a sloping axial wall and a flat pulpal wall.
6. Increasing the width and depth of the isthmus increases the danger of structural deformation and failure of the tooth itself.—MAHLER, DAVID B. (1958), *J. dent. Res.*, **37**, 516.

Strategic Endodontics

A few words of history trace the changes in professional opinion from the era of " focal infection " when every tooth in which the nerve had been removed, or in which the nerve had died, was regarded as a menace to general health and due for extraction, to the present trend where root filling is regarded as an important and necessary branch of dentistry and where the words " dead tooth " have been recognized as inaccurate, and the term " pulpless tooth " substituted.

The difference between bacteria within the root canal and bacteria externally upon the root—from which smears are usually taken after extraction—is explained, and the danger of bacteria remaining within the root canal is stressed.

The cause of granulomas and granulation tissue is discussed, together with their place and function in relation to irritation from root canal bacteria or proteolytic toxins which may come from dead, but non-infected, nerves. Warning is issued of the possibility of misinterpreting those areas of tissue resistance and repair which show as dark areas in the radiographs, apical cysts being much rarer than was believed at one time.

Gentleness, thoroughness, and asepsis combined with understanding is the keynote of the treatment.—COLQUITT, W. T. (1957), *J. prosth. Dent.*, **8**, 325.

Effects of Various Diets on the Periodontal Structures of Hamsters

Seventy-four young adult male hamsters weighing an average of 106 g. at the beginning of the experiment were divided into three groups. Animals in Group I were placed on a normal purina chow checker diet. Animals in Group II were placed on a normal granular purina chow meal diet. Animals in Group III were placed on a powdered protein-free diet.

A number of animals in each group were sacrificed after 60 days, the remainder after 120 days. Some animals in Group III received a normal diet for 60 days following 60 days of protein deprivation.

Histological observation of the periodontal tissues showed that: (1) Protein deprivation caused endosteal osteoporosis with a reduction in cellularity of the periodontal membrane. The epithelial attachment level did not appear to be affected; (2) The intake of normal

granular diet caused marked interproximal food impactions which were associated with downgrowth of the epithelial attachment, resorption of the interproximal alveolar crest, and some evidence of inflammatory infiltrate in the area. The periodontal structures of the maxillary molars showed more severe periodontal lesions than did the periodontium of the mandibular molars. (3) Restitution of a normal diet following protein deprivation reduced the endosteal osteoporosis and increased the cellularity of the periodontal membrane.—STAHL, S. S., MILLER, S. C., and GOLDSMITH, E. D. (1958), *J. Periodont.*, **29**, 7.

The Dolorogenic Denture

A dolorogenic denture is one that causes pain. The following causes of pain and their explanations are discussed:—

1. Failure to level off the elevations in the impression or the depressions in the mouth can lead to impingement of the finished denture on the nerves entering the foramina.

2. When the anterior bony ridge of either arch becomes severely resorbed, the mucosa covering it is often hypoplastic.

3. Flabby tissue is easily distorted when compound is used for a preliminary impression.

4. Denture patients often complain of pain in the lower ridge when they bite into a sandwich.

5. Two painful spots in the bicuspid areas sometimes occur.

6. Pain in the mandibular anterior ridge under the denture sometimes defies diagnosis.

7. If the tuberosity of the incisive papillae is damaged in handling the maxillary model, corresponding areas in the denture may cause pain.

8. Pain occasionally results from one tooth in an artificial denture prematurely contacting an opposing tooth.

9. Unidentifiable pain is that of the aged patient suffering perhaps from oral manifestations of the post-climacteric period.—ELFENBAUM, A. (1958), *Oral Hlth*, April, 301.

LETTER TO THE EDITOR

November 18, 1958

Sir,

Your editorial "Dental Health Instruction" (October issue) does a most valuable service to the profession by reminding us of our moral responsibility for the dental health education of patients and by pointing out the help that may be given in this direction by chairside assistants.

Most practitioners are, of course, far too busy to give the preventive aspects of dentistry the full attention they deserve. We just have not the time to give each patient an individual talk on the subject.

Yet I wonder whether we take full advantage of the simple instructional material that is available to us? Your editorial mentions the General Dental Council and the Ministry of Health. In addition, teaching aids, particularly leaflets and wall charts, are freely available from the D. & W. Gibbs Oral Hygiene Service, most of whose work I have found to be of real value. Films of high standard may also be borrowed.

Not much time or effort is required to obtain and display such material, which is designed to help us to do the job which, after all, is one of our primary responsibilities—the prevention of dental ill health through oral hygiene education.

Yours faithfully,
L. J. WALLACE

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Eaton Square,
London, S.W.1.

INTERNATIONAL ACADEMY OF ORAL PATHOLOGY

Recognizing the need for a greater interchange of knowledge and concepts between peoples of different nations, the International Academy of Oral Pathology has been formed to serve this purpose.

This organization has as its aim the pursuit of scientific knowledge, to which end periodic international conferences are planned to discuss theories, concepts, and research endeavours relating to oral disease.

Fifty fellows will ultimately constitute the entire organization and membership in the Academy will be by invitation. A founding group of seven internationally distinguished oral pathologists have accepted fellowship in the Academy, and are actively engaged in the discussion of procedural policies.

Colonel Joseph L. Bernier, D.C., U.S.A., Chief of Oral Pathology, Armed Forces Institute of Pathology, Washington, D.C., will serve as secretary and will, from time to time, announce further activities of the organization.

A CLINICAL ANALYSIS OF OROFACIAL MORPHOLOGY AND BEHAVIOUR OF 500 PATIENTS ATTENDING AN UPPER RESPIRATORY RESEARCH CLINIC

By H. L. LEECH, B.D.S., F.D.S. R.C.S., D.Orth. R.C.S.

In 1951 I had the good fortune to be appointed Clinical Assistant to the Consultant Dental Surgeon of the Victoria Hospital for Children, Chelsea, and as such, worked under the direction of Professor Ballard and Mr. Gwynne-Evans in the Upper Respiratory Research Clinic.

After much deliberation a punch-hole card filing system was drawn up with the object of assisting our researches into the relationship between the patterns of orofacial morphology and behaviour, and into their relationship with certain disorders of the upper respiratory tract in the patients attending this clinic (*Fig.* 1). This system is by no means infallible; it is only a beginning and there must be a universally accepted definition of the terminology if it is to be successful. I shall explain our interpretation of these definitions as they appear throughout this paper, which does little more than indicate the lines on which further research should be instituted, possibly on a more scientific or statistical basis.

Many of the concepts of orthodontic thinking, such as the relationship of ear, nose, and throat disorders to orthodontic irregularities, have been generally accepted, but those antagonists who propound one theory against another have been able to produce few and often false statistics to support their contentions. It was with the object of providing figures to support or deny these contentions that this research was made.

MATERIAL

The material available consisted of 500 patients attending the Upper Respiratory Research Clinic for Diseases of the Ear, Nose, and Throat. They were not selected for orthodontic purposes, and therefore the results of the research are more applicable to the general population as a whole than is the case where the research is carried out on patients selected purely from those attending an orthodontic clinic. A case history of each patient was taken with the help of the parent (nearly always the mother) and the clinical examination was supported by the lateral and occipitomental radiographs normally taken for ear, nose, and throat purposes; no cephalostat was available for the lateral radiographs and no tracings were carried out.

Those who consider lateral skull radiographic tracings essential to all research may consequently belittle this paper, but whilst such research accessories as the cephalostat may be of inestimable value we must not overlook the fact that the assessment of skeletal patterns from correlations of the various angles measured is primarily the result of clinical judgement. Furthermore, one of the values of studying lateral skull radiographic tracings is that from their constant use one can sooner or later acquire the faculty for assessing the skeletal morphology with a high degree of accuracy from the radiographs alone.

I have used the Angle's classification of the anteroposterior relationship of the teeth, assessing the relationship between the upper and lower buccal teeth in their original position of eruption in soft tissue balance and making allowances for changes of molar position due to premature loss of the deciduous teeth.

Owing to the mobility of the dento-alveolar structures on relatively fixed bases the Angle's classification does not, of course, necessarily coincide with the skeletal classification.

Given at the Jubilee Meeting held on May 9, 1958.

In most of the following illustrations I have used percentage figures to the nearest whole number.

The first illustration shows the distribution of the whole group of 500 cases using these Skeletal and Angle's classifications (*Fig.* 2).

The distribution of males and females was fairly even.

The Skeletal classification shows that there were nearly twice as many Sk. I patterns as Sk. II (Sk. I, 59 per cent; Sk. II, 32 per cent; Sk. III, 9 per cent).

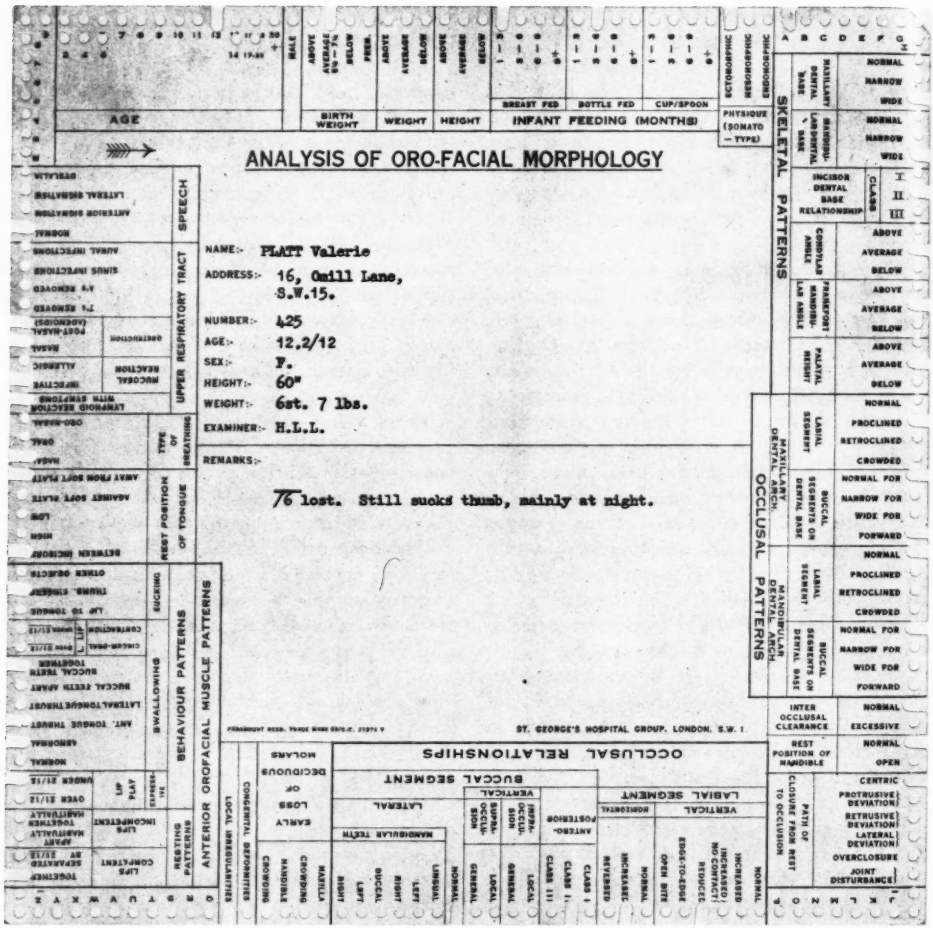

Fig. 1.—Showing a sample punch-hole card.

The average age of the patient is low, the majority having a mixed deciduous and permanent dentition; the oldest is 13 years, the youngest 2 years, and the average 7 years.

In the Angle's classification there were about twice as many Class I as Class II, division 1, and more than twice as many Class II, division 1 as Class II, division 2, or Class III (Cl. I,

56 per cent; Cl. II, div. 1, 26 per cent; Cl. II, div. 2, 10 per cent; Cl. III, 8 per cent).

Contrary to Wallis (1953), in his paper "Medical Aspects of Malocclusion", I did not find that the birth weights were lower in post-normal children but that they were similar to the Skeletal I group proportionately.

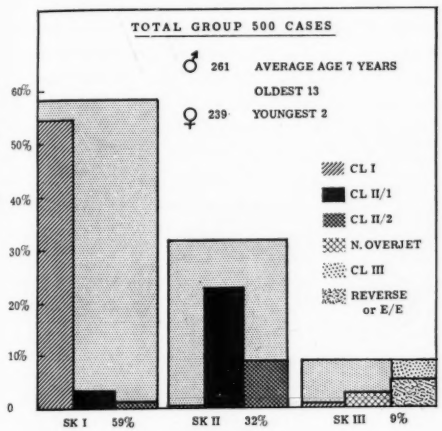

Fig. 2.

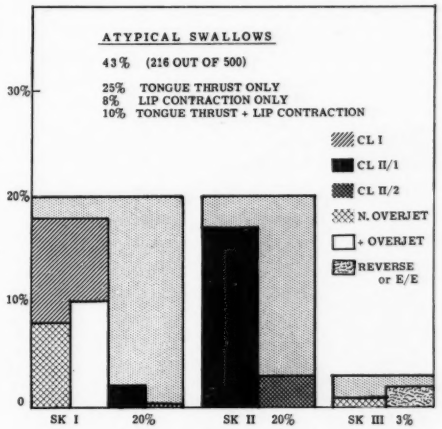

Fig. 3.

Of the 26 who were born prematurely (i.e., by international assessment birthweight 5½ lb. or less), 18 were Sk. I, 7 Sk. II, and 1 Sk. III. Similarly I found little evidence that Sk. II children were weaned earlier as he states. At 6 months of age 52·2 per cent of the Sk. II had been weaned, compared with 50·5 per cent of the Sk. I and 47·8 per cent of Sk. III. This is in comparison to his 66 per cent Sk. II and 38 per cent controls. He suggests that "post-normality is associated with a general biological inferiority", basing his deductions on the figures for prematurity, infant feeding, enlarged tonsils and adenoids, etc. My figures do not agree with his, and to me his inference is unconvincing. Having an Angle's Class II, division 2 malocclusion myself, however, I may be biased!

		Per cent	
Sk. I	Cl. I	18	4
	Cl. II, div. 1	2	
Sk. II	Cl. II, div. 1	14	3
	Cl. II, div. 2	1	
Sk. III	Cl. III	2	→ 0·4

Fig. 4.—Anterior interdental sigmatisms, 7·4 per cent (37 out of 500).

Atypical Swallowing (*Fig.* 3).—Forty-three per cent of the total had some form of atypical swallow. This figure may seem rather high compared with that of 29 per cent found by Rix (1946), but the reason will become apparent later when the skeletal distribution is mentioned. This abnormality was defined as a contraction of the circumoral musculature with the lower lip passing either over or under the upper incisors, or a thrust of the tongue forward between the upper and lower incisors with the buccal teeth apart or in occlusion, or both lip contraction and tongue thrust.

There were 10 per cent with both a tongue thrust and circumoral contraction, 25 per cent with a tongue thrust alone, and 8 per cent with a circumoral contraction alone. Since there were as many atypical swallows on Sk. II bases as Sk. I (20 per cent), whereas in the total group of 500 there were only about half as many Sk. II as Sk. I, it appears that, proportionately, atypical swallows appear to be associated with Sk. II bases twice as much as with Sk. I. The Sk. I and Sk. III relationship

is practically the same in this atypical swallow group as in the total group. Looked at in another way, about one-third of the total number of Sk. I patients, two-thirds of the

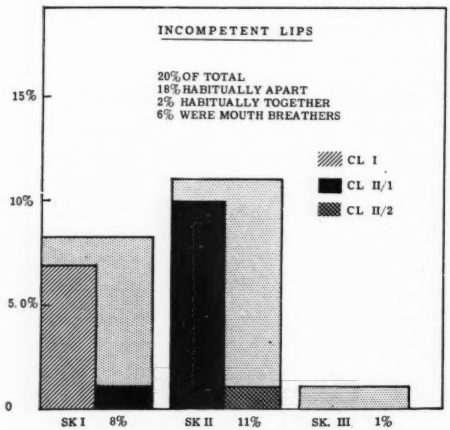

Fig. 5.

incompetent lips approximate them by contraction of the circumoral and mentalis muscles on swallowing. Consequently many of the abnormal soft-tissue behaviour patterns in these cases are most probably the result of the abnormal skeletal pattern, or at least merely an associated factor and not necessarily the cause of the malocclusion. The high figure is also most probably due to the fact that I have included in the group of abnormal swallows circumoral contraction alone without tongue thrusting.

Only on Sk. I bases can this abnormality of the soft tissue be the sole or main cause of an abnormal incisor relationship, which was an increased incisor overjet and reduced overbite or both, the tongue thrust and lip contraction enhancing one another.

On these Sk. I bases with atypical swallows, 61 per cent had an increased overjet and 31 per cent a reduced overbite.

Generally speaking, where the overjet was normal, the overbite was reduced; and where

Fig. 6.—Incompetent lips, showing the circumoral muscle contraction necessary to close them.

Sk. II, and one-third of the Sk. III had atypical swallows.

The reason for the large number of atypical swallows on Sk. II bases is most probably due to the fact that there are more incompetent lips associated with these post-normal bases (*see Fig.* 5) and that most people with the overbite was normal, the overjet increased. With premature loss of the deciduous molars in the lower jaw the retroclination of the lower incisors by the circumoral contraction appeared more marked.

In a few cases there was a Cl. II, div. 2 type of malocclusion with the circumoral

contraction retroclining both the upper and lower incisors, and yet a slightly increased overjet was maintained by the tongue thrust.

In an attempt to find a correlation between infant feeding and an atypical swallow, I noted the following:—

Of 94 out of the 500 (20 per cent) who were bottle-fed only, 43 had atypical swallows and 51 normal swallows, i.e., a fairly even distribution. There appeared, therefore, to be no direct evidence of a greater number of atypical swallows associated with lack of breast-feeding.

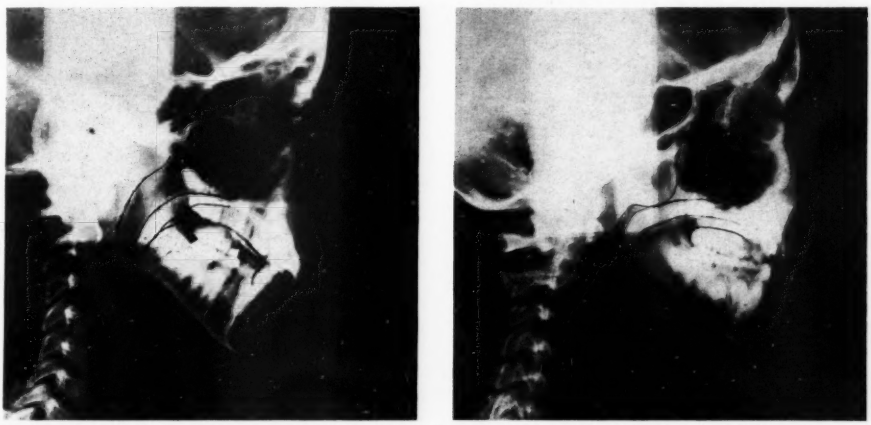

Fig. 7.—Showing a clear post-nasal airway with the tongue in contact with the soft palate, and an airway completely obstructed by adenoidal tissue with the tongue dropped away from the soft palate.

Anterior Interdental Sigmatisms (*Fig.* 4).—Thirty-seven of the 500 (just over 7 per cent of the total group) had an anterior interdental sigmatism or lisp (Sk. I, 4 per cent; Sk. II, 3 per cent; and Sk. III, 0·4 per cent). This shows a slightly higher proportion on Sk. II bases when these percentages are compared with the skeletal distribution of the total group of 500. Most of these patients had an associated tongue thrust and reduced incisor overbite, increased overjet, or both. Four patients with an interdental sigmatism had normal swallows and a normal incisor relationship.

Incompetent Lips (*Fig.* 5).—These may be defined as lips which failed to make an anterior oral seal in their rest or endogenous position (*Fig.* 6). Twenty per cent of the total had incompetent lips, but only 6 per cent of the total had incompetent lips and at the same time were actually mouth-breathing. In other words, less than one-third of those patients with their lips habitually apart were mouth-breathers, at least during the daytime. This was due, as explained by Gwynne-Evans and Ballard (1948), to the fact that although the anterior oral sphincter (the lips) was open, the posterior oral sphincter was closed by approximation of the soft palate with the base of the tongue. Mouth-breathing only ensued if there was an obstruction to a free nasal or post-nasal airway, in which case the tongue dropped away from the soft palate (*Fig.* 7). Removal of the obstruction resulted in a return to nasal breathing but the lips, of course, remained apart because they were basically incompetent.

There were many more incompetent lips proportionately on Sk. II due to the post-normality of the dental bases and the associated discrepancy between skeletal and soft-tissue form (Sk. I, 8 per cent; Sk. II, 11 per cent; Sk. III, 1 per cent). This discrepancy may be in a vertical plane, anteroposterior plane, or both. Practically all those with this "lips apart" posture closed them on swallowing by circumoral contraction.

Tonsils and Adenoids (*Figs.* 8, 9).—Ninety-three per cent of the total group had hypertrophied tonsils or adenoids or both (60 per cent had large tonsils and adenoids, 31 per cent large tonsils only, and 2 per cent large adenoids only). This again may seem rather a high figure even for an ear, nose, and throat clinic. The tonsils were considered large if they extended beyond the boundaries of the pillars of the fauces, and the adenoids large if a definable soft-tissue shadow was present on a lateral skull radiograph. Physiological hyperplasia of the tonsils accounted for the enlargements in many cases and were not producing symptoms. Those that were both hypertrophied and giving rise to symptoms and subsequently removed were 56 per cent of the total of 500; or, put in a different way, about two-thirds of those with large tonsils or adenoids or both were operated on eventually. It was not the practice to remove tonsils and adenoids simply because they were large. In many cases a period of observation resulted in the cessation of symptoms and no surgery was indicated. Only if they themselves succumbed to infection and no longer served a useful purpose were they removed.

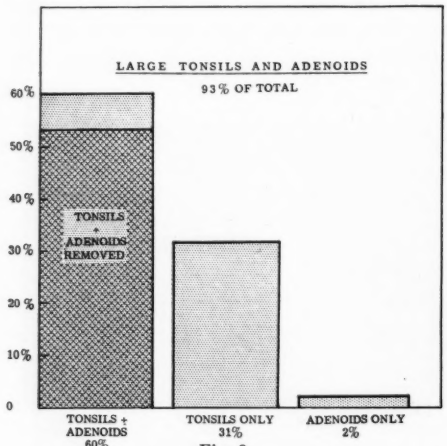

Fig. 8.

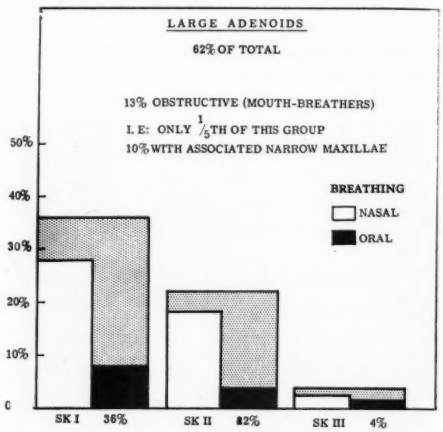

Fig. 9.

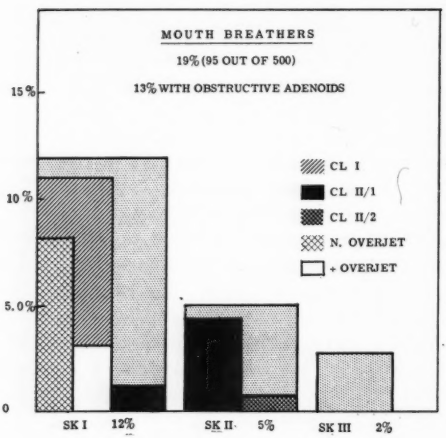

Fig. 10.

Coming to the debatable relationship between large adenoids and dental abnormalities, we find that of 62 per cent of the patients who had large adenoids 36 per cent were on Sk. I, 22 per cent on Sk. II, and 4 per cent on Sk. III bases. Adjusting our figures to relate these proportions with the incidence of Sk. I, II, and III in the total group of 500 we find that 61 per cent of the Sk. I's, 67 per cent of the Sk. II's, and 46 per cent of the Sk. III's had large adenoids. There was, therefore, a slightly higher proportion of large adenoids associated with Sk. II than with Sk. I or Sk. III. This proportion is small, and it would be unwise to suggest a cause-and-effect relationship between large adenoids

and the Sk. pattern. When the relationship is asssessed with Angle's classification of the teeth themselves, we find the following: 60 per cent of Cl. I, 66 per cent of Cl. II, div. 1; 70 per cent Cl. II, div. 2, and 51 per cent of Cl. III with mouth, as described by Gwynne-Evans and Ballard (1948; 1957) (*Fig.* 11).

It will be seen that the relationship between the skeletal patterns amongst the mouth-breathers (Sk. I, 12 per cent; Sk. II, 5 per cent; Sk. III, 2 per cent) is virtually the same as for the total group; in other words mouth-breathing does not seem to affect the skeletal or occlusal pattern. The width of the jaws similarly is unaffected, as out of the 95 of the total group who had definitely narrow jaws only 18 were mouth-breathers.

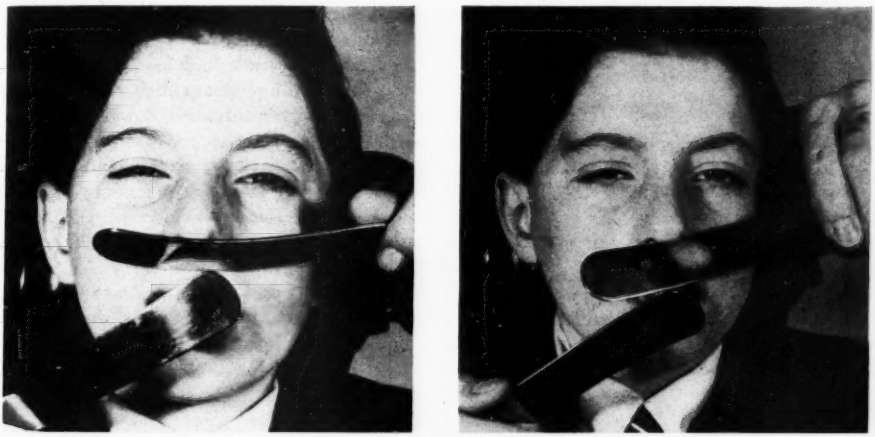

Fig. 11.—Testing for nasal or mouth-breathing by noting the breath condensation on cold metal tongue spatulas.

large adenoids. This means that large adenoids are not the prerogative of Cl. II, div. 1 patients as is sometimes thought, but more if anything of Cl. II, div. 2.

Large adenoids are also considered by some to be associated with the lateral growth of the jaws, or rather the lack of it, but my figures show that only 10 per cent of those with large adenoids had definitely narrow maxillæ.

One other important factor of this group is that only one-fifth of these large adenoids so completely obstructed the post-nasal airway as to cause true mouth-breathing.

Mouth-breathing (*Fig.* 10).—Nineteen per cent of the total group of 500 were mouth-breathers. This is made up of 13 per cent which are due to obstructive adenoids, and another 6 per cent due to allergic and infective rhinitis, sinusitis, septal defects, etc. Those with temporary colds were of course excluded. The method of testing for mouth-breathing was to notice the condensation of the breath on two cold metal tongue spatulas, one placed under the nose, and the other in front of the

Allergic Rhinitis.—Sixteen per cent (80 out of 500) showed signs and symptoms of an allergic rhinitis but only 29 of these, i.e., just over one-third, of them were mouth-breathing.

There was no preponderance of an allergic rhinitis being associated with Sk. II, the skeletal and occlusal distribution being fairly similar to that of the total group of 500; if anything slightly more Sk. III, Cl. III (Sk. I, 9 per cent; Sk. II, 5 per cent; Sk. III, 2 per cent; Cl. I, 9 per cent; Cl. II, div. 1, 4 per cent; Cl. II, div. 2, 1·0 per cent; Cl. III, 2 per cent).

Anterior Open Bite (*Fig.* 12).—Twenty-one out of 500, i.e., approximately 4 per cent, had an anterior open bite and these were distributed on the skeletal pattern very similar to the total distribution (Sk. I, 2 per cent;

Sk. II, 1·6 per cent; Sk. III, 0·4 per cent). The age group was 3½ to 8 years.

All had an atypical swallow with a tongue thrust and 9 out of the 21 an anterior interdental sigmatism. Just over one half were sucking a dummy or thumb at the time of investigation. In many cases the tongue rested permanently between the upper and lower incisors and against the lower lip.

Sk. I	Cl. I	9
	Cl. II, div. 1	2
Sk. II	Cl. II, div. 1	8
Sk. III	Cl. III	2

Fig. 12.—Anterior open bite, 4 per cent (21 out of 500).

Support is given to the belief that anterior open bites are in most instances due to a form of obstruction to the vertical development of the incisors, be it dummy, thumb, tongue, or a combination of these factors.

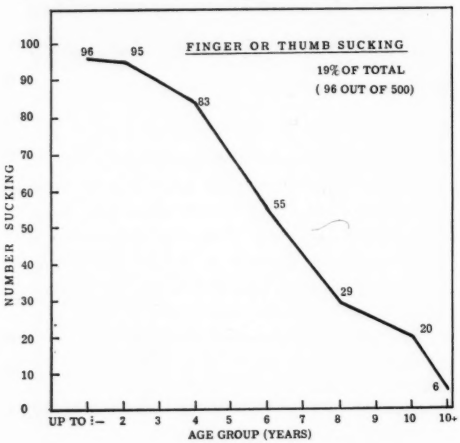

Fig. 13.

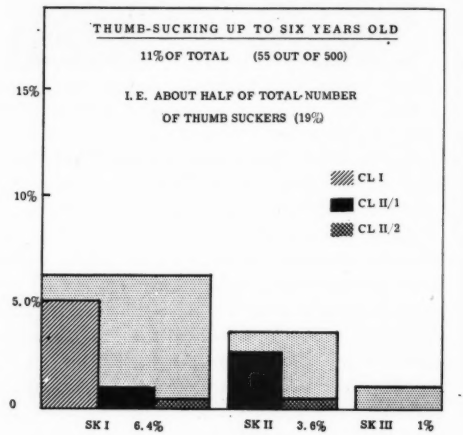

Fig. 14.

Three of the 21 had no obvious obstructive causes but had a high Frankfort-mandibular plane angle, with a consequently much greater vertical height in the anterior than posterior region.

Thumb- and Finger-sucking (*Figs.* 13, 14).—Nineteen per cent (96 out of 500) sucked their fingers or thumb at some time or another. The average age for this group was 7 years, the eldest being 12 and the youngest 3, with a slightly higher proportion amongst the males. All but one had sucked for at least two years.

About one half were still sucking at 6 years of age. This is comparable to the figure of 11·2 per cent at 5 years of age given by Gardiner (1956) for his Sheffield schoolchildren. Roughly two-thirds had ceased at the time of eruption of the permanent incisors, i.e., about 6 per cent of the total of 500 were still sucking at 8 years of age.

The figures for those still sucking at 6 years of age were: Sk. I, 6·4 per cent; Sk. II, 3·6 per cent; Sk. III, 1 per cent; Cl. I, 5 per cent; Cl. II, div. 1, 4 per cent; Cl. II, div. 2, 1 per cent; Cl. III, 1 per cent.

Comparing these figures with the total group of 500 the ratio for the skeletal pattern is very similar to the total group, showing that the habit does *not* affect the skeletal pattern. The occlusion of the teeth is, as would be expected, affected with a proportionate preponderance of Cl. II, div. 1.

Of those of all ages still sucking, about two-thirds had a tongue thrust. On the Sk. I patterns 26 actually had normal swallows and 19 of them *normal* incisors.

If, as is suggested by these figures, thumb-sucking affects the occlusion only, the effect on the incisor relationship can only be truly

judged on the Sk. I patterns still sucking, of which there were 42. Here there were slightly more increased overjets than normal overjets (23 compared with 19) and a tendency for the overbite to be reduced (including 4 anterior open bites).

Out of this group of 42 still sucking, with a Sk. I base, 14 had a normal incisor relationship and 5 actually had an *increased* incisor overbite, but these latter had no tongue thrusts.

On the Sk. III pattern only 1 out of the 5 had a reverse overjet, suggesting that in these cases the habit tended to correct the incisor relationship.

Summing up, the habit seems to affect the occlusion only, not the skeletal pattern, and where the incisors are affected, there is nearly always an associated tongue thrust. Which plays the dominant role, the thumb or the tongue, I leave you to judge, but it is probable that they enhance one another. In the realm of malocclusion I personally would put thumb-sucking very low down in the aetiological scale. To quote Professor Ballard (1957 b): "inherited morphology of bone and soft tissue and the inherited or endogenous patterns of activity of the orofacial soft tissues are the causes of malocclusions, with habit posture and activities superimposed and confusing the diagnosis."

It is also interesting to reflect on the views expressed in a recent letter to the *British Medical Journal* by Mr. H. F. Welbourn of Kampala, Uganda, on patients attending the Welfare Clinic in Kampala who sucked their thumbs: "the deformity of the maxilla is far less often seen here than in Europe. Perhaps because the attitude of the African parent is more often one of condolence and amusement rather than of irritation and shame, African children tend to grow out of the habit more rapidly." Apart from the psychological effect of thumb-sucking the habit is apparently not free from superstition, as the Africans believe that a child who sucks his thumb will eventually kill his father, whereas one who sucks his fingers will grow up to be placid and content!

The relationship between thumb-sucking and feeding is shown by the following figures: Of 20 per cent of the total group of 500 who were bottle-fed only, 3 per cent were thumb-sucking, i.e., only about one-seventh of those who were bottle-fed only, sucked their thumbs. This seems to indicate no relationship between the habit and lack of breast-feeding.

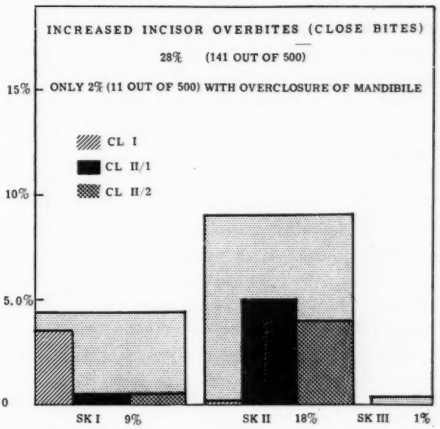

Fig. 15.

"Close Bites"—Increased Incisor Overbite (*Fig.* 15).—There were 28 per cent (141 out of the 500) with increased incisor overbites and these were distributed as follows:—

Sk. I, 9 per cent; Sk. II, 18 per cent; Sk. III, 1 per cent; Cl. I, 7 per cent; Cl. II, div. 1, 11 per cent; Cl. II, div. 2, 8 per cent; Cl. III, 1·5 per cent.

As will be seen, there are far more "close bites" on Sk. II bases, and compared with the total group of 500 distribution there are also far more on the Cl. II, div. 2 than on the Cl. II, div. 1 malocclusion.

In attempting to assess a true overclosure of the mandible to maxillæ on closure from the rest position to occlusion, the inter-occlusal clearance or freeway space was assessed using various methods of registering the rest position on endogenous mandibular posture as described by Ballard (1955).

The figure of 2 per cent only of the 500 with overclosure is low. In other words, only one-fourteenth of the increased incisor overbites showed an overclosure of the mandible from the rest to the occlusal position. Allowing for

a clinical error of as much as 50 per cent, this figure would still be very small.

Of these 11 overclosures, 6 were on Cl. II, div. 2, 3 on Cl. III, and 2 on Cl. I malocclusions.

There was a slight tendency for the Frankfort-mandibular plane angle to be low with increased and normal overbites and high with reduced overbites. This may be associated with a tendency for the lips to be more competent on low Frankfort-mandibular plane angles.

In contrast to the foregoing, 15 of the 141 with close bites sucked their thumbs and 9 were still sucking at the time of investigation!

Ballard (1957 a) has discussed the aetiology of "close bite" in detail in his Presidential Address to this Society, and the figures I have produced support his contentions.

Summing up it seems certain that most increased incisor overbites are *not* due to overclosure of the mandible (i.e., true close bites); they are due to an abnormal incisor relationship when either the upper or lower incisors or both are on a different occlusal level than the buccal teeth (where present), and the reasons for this have been fully discussed by Ballard (1957 a).

On Sk. I bases the altered axial inclination is due to an abnormal soft tissue behaviour, or possibly early loss of the deciduous teeth in the lower jaw, or both. The early loss in the lower jaw does not necessarily cause an overclosure but allows the lower incisors to become retroclined and lose their normal contact with the upper incisors. This is evident from the fact that early loss in the upper jaw does not result in a close bite (i.e., due to overclosure). On Sk. II bases the abnormal incisor relationship is due to the same causes as on Sk. I or, as is most likely, the post-normality of the skeletal bases, or both.

An abnormal incisor relationship will not necessarily give rise to a close bite if the tongue, thumb, or high Frankfort-mandibular angle prevents it.

It is possible to have an overclosure of the mandible (where there is a large freeway space) *without* a close bite (4 cases) if the incisor relationship is normal.

Acknowledgements.—I would like to thank first and foremost Professor Ballard and Mr. Gwynne-Evans for their help and encouragement in instigating and carrying out this work; the various photographic departments for the production of the slides; Mr. P. M. C. James who helped to compile the graphs; and finally, St. George's Hospital for their financial aid in the creation of this particular punch-hole card filing system.

REFERENCES

BALLARD, C. F. (1955), *Trans. Brit. Soc. Orthodont.*, 117.
— — (1957 a), *Dent. Practit.*, **8**, 42.
— — (1957 b), "Co-report on Habits to the International Dental Congress". Rome.
GARDINER, J. H. (1956), *Dent. Practit.*, **6**, 187.
GWYNNE-EVANS, E. (1956), *Med. Pr.*, **235**, 246.
— — and BALLARD, C. F. (1948), *Dent. Rec.*, **68**, 1.
— — — — (1957), *Proc. R. Soc. Med.*, **51**, 279.
RIX, R. E. (1946), *Dent. Rec.*, **66**, 103.
WALLIS, H. R. E. (1953), *Trans. Brit. Soc. Orthodont.*, 40.

DISCUSSION

The Chairman asked Professor Ballard to open the discussion.

Professor Ballard thanked and congratulated Mr. Leech for producing such an interesting paper and collection of facts. Then he thanked him personally for spending so much time at Tite Street and for subsequently producing his analysis of the recordings.

The punch-hole card system which Mr. Leech had mentioned was produced after several years of discussion between Mr. Tulley, Mr. Gwynne-Evans, and Professor Ballard, with Mr. Walther coming in subsequently and Mr. Leech. The headings were the result of discussion and several years of clinical observation, and the exact meaning of all the headings had been defined.

The important thing about Mr. Leech's paper was that it had shown what had been suspected, that if one classified morphology correctly in relation to malocclusions and if one added to that classifications of various habit activities, in the end one would have a true perspective of the various factors in relation to the production of malocclusion.

Mr. Leech had said that he thought finger- and thumb-sucking was a very unimportant factor; that was a conclusion which had been arrived at by clinical observation, but figures such as those produced by Mr. Leech were necessary before one could in fact be sure of one's observations. Mr. Leech's figures supported the view that most of the malocclusions were the result of inherited variations and that external factors only tended to add to the diagnostic problem; that finger- and thumb-sucking only tended to increase an abnormality which had been there already.

As he had mentioned, Mr. Leech's figures on finger- and thumb-sucking were the same as Gardiner's. In a statistical analysis by people such as Gardiner and in a study on infants by Lehrner (1955) one did not find

support for finger- and thumb-sucking as an aetiological factor, and he thought most of the statements had arisen in the past from a purely subjective approach. Mr. Leech had asked which played the prominent part, the thumb or the tongue, and in this respect it was interesting that he found that 15 out of 141 with an excessive overbite sucked their thumbs. This might suggest that in fact, as previously stated, it was the tongue-thrusting which was the important factor in anterior open bite when tongue and thumb were associated. It was known from a serial study of infants that both with finger- and thumb-sucking, and particularly with tongue thrusting, as the dento-alveolar structures develop into a larger maxillary space the influence of finger- and thumb-sucking has less effect on those alveolar structures. That has led to people concluding that their treatments to control finger- and thumb-sucking had in fact produced improvement in malocclusion, but the serial studies had shown that that would have taken place anyway.

With regard to bottle feeding, Friel in 1948 studied serially children who had been cup fed from birth. The interesting thing was that the cup-fed infants were psychologically more stable than some of the breast-fed children, and at the end of ten years they showed no dental abnormalities.

On the relationship between overclosure and close bites, he suggested that the figure of 2 per cent only of the 500 showing overclosure was not low, as Mr. Leech suggested, but high. He would have liked to discuss this with Mr. Leech before. He used to find a fairly high percentage, 2 or 3 per cent, of cases in which he would say there was an overclosure, and he thought he was making the error of not assessing for the endogenous postural position. In other cases many may have tongue to lower lip activity, and most of those cases if there was increased overjet also pushed the mandible downwards and forwards, so apparently showing an increased interocclusal clearance.

He was sorry that Mr. Leech did not see Dr. Wallis's point because he thought it was a reasonable conclusion to reach. He suggested that the type of Class II mentioned by Dr. Wallis was not in fact the post-normality that Mr. Leech had mentioned. Mr. Leech had said that Dr. Wallis found his post-normal cases were taller. Dr. Wallis's cases were probably Class II, division 1 cases.

Professor Ballard felt fairly confident that Mr. Leech could not prove one statement he had made, but it was a minor point. He had said that with the premature loss of the deciduous molars in the lower jaw the retroclination of the lower incisors by the circumoral contraction was more marked. Professor Ballard had already pointed out that he thought there was a limit to the degree of collapse following early loss of deciduous teeth. He suggested the retroclination of the lower incisors, as Mr. Leech had classified it, in association with circumoral contraction was not a collapse of the segment secondary to early loss but in fact was retroclined lower segment initially as a result of the circumoral contraction which enhanced the anteroposterior crowding in the arch. In other words, he did not think a collapse like that was of the order of more than about 4° of change of axial inclination. It was only by serial study that one could check that there was a possible error of observation of that kind.

In conclusion Professor Ballard said he would again like to congratulate Mr. Leech. An investigation with a slightly different classification had to be done with very much larger numbers. He hoped that perhaps the Royal Dental Hospital would do something of the sort.

The Chairman asked Mr. Gwynne-Evans to continue the discussion.

Mr. Gwynne-Evans said he was only going to generalize for a moment or two and to add to what Professor Ballard had already said in opening the discussion.

As the members would know, the Upper Respiratory Clinic was composed of three specialities—rhinology, orthodontics, and speech therapy. No one would know more than he the difficulties that Mr. Leech had to surmount in drawing up and interpreting a definite inquiry into the relationship of so many variable factors. It had given him no small degree of satisfaction to see produced the conclusive results of this united endeavour.

He thanked Mr. Leech for the patience and time he had given to this Clinic and for preparing such an enlightening paper. Whether other workers would agree with his figures or his conclusions mattered little at this stage. What mattered was the method that was being used to unravel in an orderly manner the tangle of associated factors which were not necessarily interdependent. In the past, wrong correlations had led to wrong assumptions, and the method of analysis demonstrated should go far to prove or disprove many time-honoured cause–effect relationships. He would like to see the punch-hole card, which they had taken so much trouble to design, used by other hospitals and schools because a comparison of findings by different workers using the same method of analysis should lead us very near to the truth.

The Chairman opened the paper for general discussion.

Mr. W. J. Tulley said he thought the paper justified the Jubilee Meeting and was a turning point in the history of the Society because he had produced proof of something they had all been hearing of for quite a long time, and that some people were still disbelieving. He hoped that Mr. Leech had gone a long way to converting them.

With regard to the figure of 4 per cent open bite, he gathered negative overbite had been meant and not the number with no lower to upper incisor contact. Then he asked if he had heard correctly that Mr. Leech had defined incompetent lips as those which could not effect a seal at rest. He would not define lips as incompetent if they could not effect a seal at rest because interposed teeth were merely stopping their contact.

Mr. J. H. Hovell endorsed all that Mr. Tulley had said about the value of the paper. There were just one or two points he wished to mention.

There was a difference between Mr. Leech's figures on atypical swallowing and those produced by Rix; his figures were somewhat higher, and he did not offer a convincing explanation. There were two points on which he would like to hear Mr. Leech's comments; the first was the possibility of there being some unexplained connexion between atypical swallowing and respiratory disease, and the other was the method of assessing atypical swallowing, which Mr. Hovell had found very difficult. If one actually told a patient to swallow one would get an atypical swallow from a patient who normally swallowed in quite a normal way, not in an atypical way. The other point was the contraction of the lip when one had an incompetent lip morphology.

A point which was very important was that the figures had been taken from the Upper Respiratory

a clinical error of as much as 50 per cent, this figure would still be very small.

Of these 11 overclosures, 6 were on Cl. II, div. 2, 3 on Cl. III, and 2 on Cl. I malocclusions.

There was a slight tendency for the Frankfort-mandibular plane angle to be low with increased and normal overbites and high with reduced overbites. This may be associated with a tendency for the lips to be more competent on low Frankfort-mandibular plane angles.

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An abnormal incisor relationship will not necessarily give rise to a close bite if the tongue, thumb, or high Frankfort-mandibular angle prevents it.

It is possible to have an overclosure of the mandible (where there is a large freeway space) *without* a close bite (4 cases) if the incisor relationship is normal.

Acknowledgements.—I would like to thank first and foremost Professor Ballard and Mr. Gwynne-Evans for their help and encouragement in instigating and carrying out this work; the various photographic departments for the production of the slides; Mr. P. M. C. James who helped to compile the graphs; and finally, St. George's Hospital for their financial aid in the creation of this particular punch-hole card filing system.

REFERENCES

BALLARD, C. F. (1955), *Trans. Brit. Soc. Orthodont.*, 117.
— — (1957 a), *Dent. Practit.*, **8**, 42.
— — (1957 b), "Co-report on Habits to the International Dental Congress". Rome.
GARDINER, J. H. (1956), *Dent. Practit.*, **6**, 187.
GWYNNE-EVANS, E. (1956), *Med. Pr.*, **235**, 246.
— — and BALLARD, C. F. (1948), *Dent. Rec.*, **68**, 1.
— — — — (1957), *Proc. R. Soc. Med.*, **51**, 279.
RIX, R. E. (1946), *Dent. Rec.*, **66**, 103.
WALLIS, H. R. E. (1953), *Trans. Brit. Soc. Orthodont.*, 40.

DISCUSSION

The Chairman asked Professor Ballard to open the discussion.

Professor Ballard thanked and congratulated Mr. Leech for producing such an interesting paper and collection of facts. Then he thanked him personally for spending so much time at Tite Street and for subsequently producing his analysis of the recordings.

The punch-hole card system which Mr. Leech had mentioned was produced after several years of discussion between Mr. Tulley, Mr. Gwynne-Evans, and Professor Ballard, with Mr. Walther coming in subsequently and Mr. Leech. The headings were the result of discussion and several years of clinical observation, and the exact meaning of all the headings had been defined.

The important thing about Mr. Leech's paper was that it had shown what had been suspected, that if one classified morphology correctly in relation to malocclusions and if one added to that classifications of various habit activities, in the end one would have a true perspective of the various factors in relation to the production of malocclusion.

Mr. Leech had said that he thought finger- and thumb-sucking was a very unimportant factor; that was a conclusion which had been arrived at by clinical observation, but figures such as those produced by Mr. Leech were necessary before one could in fact be sure of one's observations. Mr. Leech's figures supported the view that most of the malocclusions were the result of inherited variations and that external factors only tended to add to the diagnostic problem; that finger- and thumb-sucking only tended to increase an abnormality which had been there already.

As he had mentioned, Mr. Leech's figures on finger- and thumb-sucking were the same as Gardiner's. In a statistical analysis by people such as Gardiner and in a study on infants by Lehrner (1955) one did not find

support for finger- and thumb-sucking as an aetiological factor, and he thought most of the statements had arisen in the past from a purely subjective approach. Mr. Leech had asked which played the prominent part, the thumb or the tongue, and in this respect it was interesting that he found that 15 out of 141 with an excessive overbite sucked their thumbs. This might suggest that in fact, as previously stated, it was the tongue-thrusting which was the important factor in anterior open bite when tongue and thumb were associated. It was known from a serial study of infants that both with finger- and thumb-sucking, and particularly with tongue thrusting, as the dento-alveolar structures develop into a larger maxillary space the influence of finger- and thumb-sucking has less effect on those alveolar structures. That has led to people concluding that their treatments to control finger- and thumb-sucking had in fact produced improvement in malocclusion, but the serial studies had shown that that would have taken place anyway.

With regard to bottle feeding, Friel in 1948 studied serially children who had been cup fed from birth. The interesting thing was that the cup-fed infants were psychologically more stable than some of the breast-fed children, and at the end of ten years they showed no dental abnormalities.

On the relationship between overclosure and close bites, he suggested that the figure of 2 per cent only of the 500 showing overclosure was not low, as Mr. Leech suggested, but high. He would have liked to discuss this with Mr. Leech before. He used to find a fairly high percentage, 2 or 3 per cent, of cases in which he would say there was an overclosure, and he thought he was making the error of not assessing for the endogenous postural position. In other cases many may have tongue to lower lip activity, and most of those cases if there was increased overjet also pushed the mandible downwards and forwards, so apparently showing an increased interocclusal clearance.

He was sorry that Mr. Leech did not see Dr. Wallis's point because he thought it was a reasonable conclusion to reach. He suggested that the type of Class II mentioned by Dr. Wallis was not in fact the post-normality that Mr. Leech had mentioned. Mr. Leech had said that Dr. Wallis found his post-normal cases were taller. Dr. Wallis's cases were probably Class II, division 1 cases.

Professor Ballard felt fairly confident that Mr. Leech could not prove one statement he had made, but it was a minor point. He had said that with the premature loss of the deciduous molars in the lower jaw the retroclination of the lower incisors by the circumoral contraction was more marked. Professor Ballard had already pointed out that he thought there was a limit to the degree of collapse following early loss of deciduous teeth. He suggested the retroclination of the lower incisors, as Mr. Leech had classified it, in association with circumoral contraction was not a collapse of the segment secondary to early loss but in fact was retroclined lower segment initially as a result of the circumoral contraction which enhanced the anteroposterior crowding in the arch. In other words, he did not think a collapse like that was of the order of more than about 4° of change of axial inclination. It was only by serial study that one could check that there was a possible error of observation of that kind.

In conclusion Professor Ballard said he would again like to congratulate Mr. Leech. An investigation with a slightly different classification had to be done with very much larger numbers. He hoped that perhaps the Royal Dental Hospital would do something of the sort.

The Chairman asked Mr. Gwynne-Evans to continue the discussion.

Mr. Gwynne-Evans said he was only going to generalize for a moment or two and to add to what Professor Ballard had already said in opening the discussion.

As the members would know, the Upper Respiratory Clinic was composed of three specialities—rhinology, orthodontics, and speech therapy. No one would know more than he the difficulties that Mr. Leech had to surmount in drawing up and interpreting a definite inquiry into the relationship of so many variable factors. It had given him no small degree of satisfaction to see produced the conclusive results of this united endeavour.

He thanked Mr. Leech for the patience and time he had given to this Clinic and for preparing such an enlightening paper. Whether other workers would agree with his figures or his conclusions mattered little at this stage. What mattered was the method that was being used to unravel in an orderly manner the tangle of associated factors which were not necessarily interdependent. In the past, wrong correlations had led to wrong assumptions, and the method of analysis demonstrated should go far to prove or disprove many time-honoured cause–effect relationships. He would like to see the punch-hole card, which they had taken so much trouble to design, used by other hospitals and schools because a comparison of findings by different workers using the same method of analysis should lead us very near to the truth.

The Chairman opened the paper for general discussion.

Mr. W. J. Tulley said he thought the paper justified the Jubilee Meeting and was a turning point in the history of the Society because he had produced proof of something they had all been hearing of for quite a long time, and that some people were still disbelieving. He hoped that Mr. Leech had gone a long way to converting them.

With regard to the figure of 4 per cent open bite, he gathered negative overbite had been meant and not the number with no lower to upper incisor contact. Then he asked if he had heard correctly that Mr. Leech had defined incompetent lips as those which could not effect a seal at rest. He would not define lips as incompetent if they could not effect a seal at rest because interposed teeth were merely stopping their contact.

Mr. J. H. Hovell endorsed all that Mr. Tulley had said about the value of the paper. There were just one or two points he wished to mention.

There was a difference between Mr. Leech's figures on atypical swallowing and those produced by Rix; his figures were somewhat higher, and he did not offer a convincing explanation. There were two points on which he would like to hear Mr. Leech's comments; the first was the possibility of there being some unexplained connexion between atypical swallowing and respiratory disease, and the other was the method of assessing atypical swallowing, which Mr. Hovell had found very difficult. If one actually told a patient to swallow one would get an atypical swallow from a patient who normally swallowed in quite a normal way, not in an atypical way. The other point was the contraction of the lip when one had an incompetent lip morphology.

A point which was very important was that the figures had been taken from the Upper Respiratory

Clinic and not from a large cross-section of the population. One might think, therefore, that there would be an abnormally large number of mouth-breathers. In an orthodontic clinic as opposed to a respiratory clinic the amounts would be much smaller than those given by Mr. Leech, and he had not said how many mouth-breathers had competent lips. Mr. Hovell did not think the condition of the lips had anything to do with mouth-breathing; he thought people breathed through their mouths because they had an obstruction to the nasal respiration, and they could get that with competent lips. In order to assess the competence of lips in a child who breathed through its mouth, the child had to stop breathing for a period.

Professor Ballard had made a point about Mr. Leech's assessment of overclosure, and Mr. Hovell also thought his assessment of overclosure was high rather than low. He would put it very much lower.

Mr. W. A. Nicol thanked Mr. Leech very much for his paper. He did not wish to imply any criticism of the paper as such, but he did think it would be of value to many members who were not immersed in this type of work if in a paper of this description, which was purely statistical, they could have some prior notice of the figures, perhaps with the Notice convening the Meeting.

With regard to the differences with Dr. Wallis's work, Mr. Nicol pointed out that Dr. Wallis's work had been done on a pure random sample, a sample of school-children as they came up for medical examination. Some of the differences may be accounted for in that way.

Mr. J. S. Beresford said that it would be helpful if Mr. Leech could give a good definition of "competent" and "incompetent" and also, perhaps, "endogenous postural position". Could that not be changed a little, he wondered, because to him "postural" and "position" meant almost the same thing. Mr. Beresford said he could not do it, but he felt sure Mr. Leech could.

The Chairman said that he had asked on many occasions for someone to define competent lips and he had been astonished to hear Mr. Leech define it in the way he did.

Going round hospitals he had come into contact with a number of E.N.T. surgeons who had varying ideas on mouth-breathing. Some of them frequently sent patients asking for them to be provided with oral screens to prevent them from breathing through their mouths. Others state that patients breathe through their mouths only if they are prevented by obstruction from breathing through the nose. The condition of the mucous membrane might vary from time to time or even from room to room, so that although the nasal passages were clear one minute they might be obstructed shortly afterwards. They deprecated oral screens.

Mr. Leech thanked Professor Ballard and Mr. Gwynne-Evans for their remarks and for opening the discussion on his paper. He did not think there was really anything which they had said to which he needed to reply.

In reply to Mr. Tulley on the point of normal occlusion, he said he had seen very few indeed with true normal occlusion, but it depended upon one's assessment of "normal occlusion" and "malocclusion", the degree to which the teeth had to be out of relationship with one another to be in malocclusion. He had tended to classify many of them as Class I, in actual fact there were very few who were really in true normal occlusion.

The open bite was a very difficult thing to assess even with measuring the occlusal plane, but he put those cases into the category of open bite if there was not just a reduced overbite or an edge-to-edge bite but less than an edge-to-edge bite.

As one could see, the difficulty with the punch-hole card system was to define all the various types of irregularity. It was very difficult to get a definition and they had had much difficulty agreeing even among themselves what was the definition, for example, of competent lips. Mr. Leech did not know that he could give a really satisfactory definition of incompetent lips. He had said that these were defined as lips which failed to make an anterior-oral seal in their rest position. He would say that competent lips were those which were in contact with each other in the normal rest position of the lips, that is to say with no obvious contraction of the circumoral muscles, and with the mandible in its endogenous postural position.

Mr. Hovell had asked about the relationship between the abnormal swallow and E.N.T. disorders. Mr. Leech said he would not like to commit himself on that at all. Whether there was a lack of post-nasal drainage in people with an abnormal swallow or not he thought was very difficult to assess. He had stated his assessment of the abnormal swallow and produced his figures for his own assessment, but that may not be in agreement with someone else's assessment for abnormal swallow. He had mentioned two main things, the thrust of the tongue and the contraction of the lips, and in drawing up the punch-hole card system that presented quite a lot of difficulty. Eventually, under the behaviour patterns, the following items had been put down under the heading of swallowing: Normal, abnormal, anterior tongue thrust, lateral tongue thrust, buccal teeth apart, buccal teeth together. If one asked one patient to swallow it might be a patient who would make "quite a meal of it" whereas another might have a very slight contraction of the lips and a very slight tongue thrust, which would hardly be classified as abnormal at all. There were, of course, various degrees of abnormality between these two extremes. It would be impossible to lay down a hard-and-fast rule for an abnormal swallow. He thought he had perhaps erred a little on the high side. He always looked at the soft tissue behaviour as soon as the patient sat down in the chair and while he was asking for the age and so on, never making the patient conscious of the fact that he was looking at the teeth. One advantage of working in an E.N.T. clinic was that the patients did not know what the orthodontist was looking for!

Mr. Leech was sorry he had not produced figures for competent lips in mouth-breathers; he had the figures but he had not managed to get them collated, but he said he would produce them, perhaps in the form of another short communication.

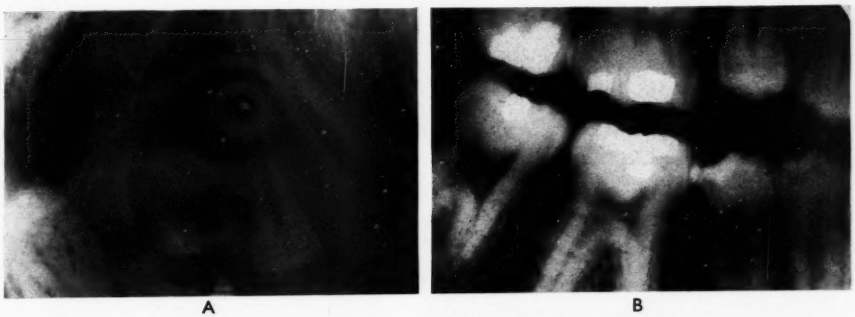
He thanked Mr. Nicol and Mr. Oliver for their remarks, and also Mr. Beresford. He thought he had answered all the questions included in their remarks, and also the Chairman's.

The Chairman said that everyone associated with Mr. Leech knew the meticulous care with which he dealt with any problems, whether in regard to the work of the Society, clinical work, or for the preparation of a paper. Statistical papers were often thought of as being very dull, and it said a great deal for Mr. Leech that his had been instructive, interesting, and amusing.

ATYPICAL PATHS OF ERUPTION: SOME CAUSES AND EFFECTS

By J. S. ROSE, B.D.S., F.D.S., D.Orth. R.C.S.

THE problem of eruption is a difficult one because there is no really satisfactory explanation of the process. Though there have been many theories concerning eruption, the only point of agreement would appear to be that there is some mechanism that causes a tooth to move from its developmental position to its position of occlusion. Whatever this mechanism is, it would seem to have considerable force on some occasions. For instance, in 1952 Wilson showed two cases where second premolar spaces had been completely re-opened, apparently by the erupting tooth forcing its way between the first premolar and the first molar. Again, the crowns of erupting teeth may come into contact with roots of already erupted teeth, and cause their displacement, and sometimes even their resorption. I think root resorption is more likely to occur if the tooth being pressed on is not free to move. The displacement of an upper second incisor by the developing canine is an obvious example of this. But if the crowding is tight enough to prevent the lateral from moving, then pressure from the canine may cause resorption of the incisor root. If a deciduous tooth is being resorbed, then pressure on its root from a successional tooth may well hasten the process. Occasionally the developing premolar lies obliquely between the roots of the deciduous tooth. In this case, during eruption more pressure will be placed upon one of the roots and this one will resorb more rapidly.



A B

Fig. 1.—Self-correction of $\underline{5}|$ after extraction of retained $\underline{E}|$.

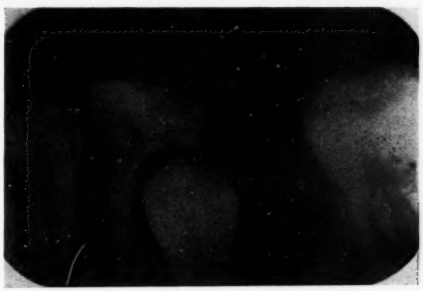


Fig. 2.—$|\overline{6}$ lost. Resorption of the distal root of $|\overline{E}$ allowing $|\overline{5}$ to move distally.

A given force is said to have magnitude and direction. If there is a force of eruption, then it is necessary for there to be control of the direction of that force. Assuming that a tooth is in its normal developmental position, we know that it will erupt towards the surface; and that once it has broken the surface it will continue on its path until it reaches some form of opposition. When a tooth has erupted into

Given at the Jubilee Meeting held on May 10, 1957.

the oral cavity it will come under the directional control of the adjacent teeth and soft tissues, and thus be guided into a position of stability, where it will stay unless its environment is changed. It is that change of normal environment and its effect on the direction of eruption with which I am concerned in this paper.

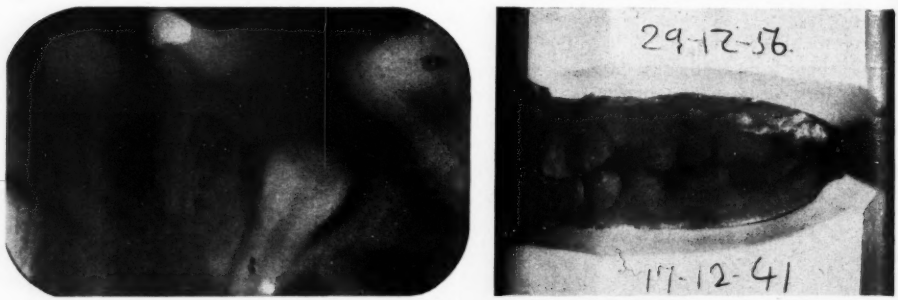


Fig. 3.—$\overline{|6}$ lost. $\overline{|E}$ retained. $\overline{|5}$ travelling distally.

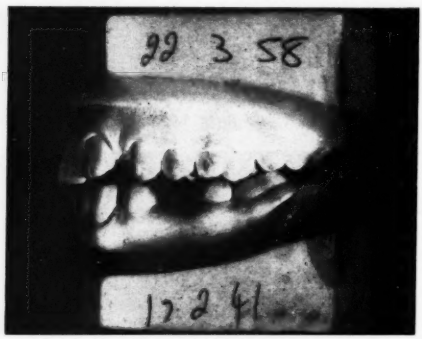
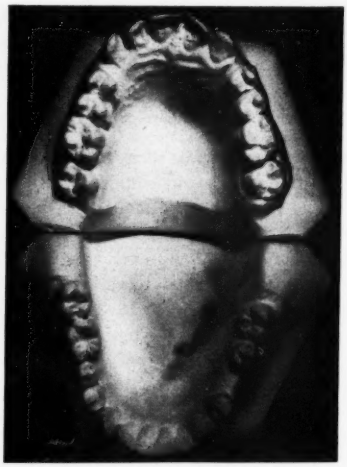


Fig. 4.—The same case as *Fig.* 3 after extraction of $\overline{|E}$. $\overline{|5}$ has erupted into contact with $\overline{|7}$.



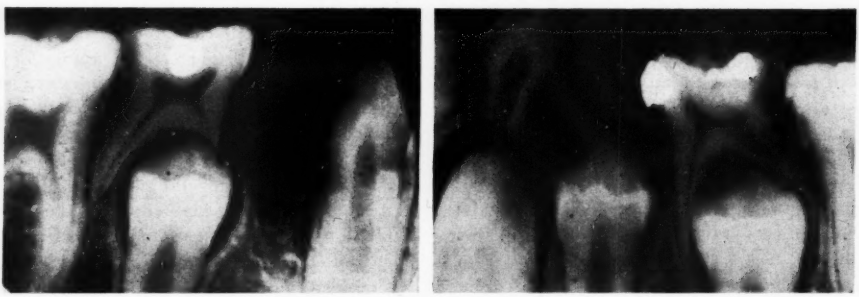


Fig. 5.—$\overline{|4}$ has been extracted. The mesial root of $\overline{E|}$ has resorbed. $\overline{5|}$ is moving mesial to $\overline{E|}$. Note the uneven resorption of the roots of $\overline{E|}$.

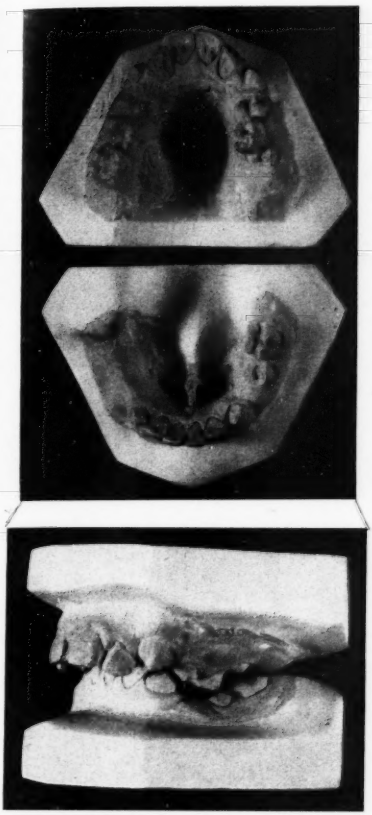
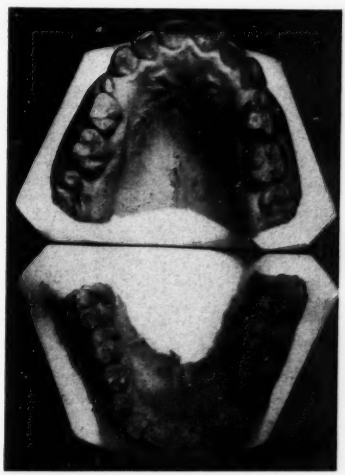


Fig. 6.—$\underline{|6}$ has been extracted. $\underline{|5}$ is erupting distal to the retained $\underline{|E}$.

It is well known that a retained deciduous incisor will cause an erupting successor to change its path and come into a position of lingual occlusion. This is, of course, a simple example of change in environment surrounding the erupting tooth, and because of this the normal guiding forces cannot exert their anticipated influences. The result is a local malocclusion.

A very similar picture would appear to take place within the alveolus. Normally a developing premolar will be found between the roots of its deciduous predecessor. These roots will serve to guide the successional tooth towards the alveolar surface, so long as they resorb relatively evenly, and so long as the contiguous teeth are in normal positions. Within



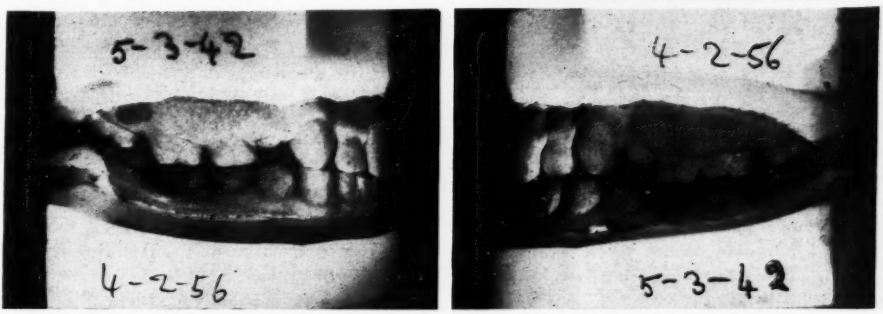


Fig. 7.—$\underline{4|4}$ have been enucleated. $\underline{E|E}$ are retained and $\underline{5|5}$ are erupting into $\underline{4|4}$ spaces.

these limits considerable self-correction of a misplaced tooth is possible. For example, *Fig.* 1 A shows a misplaced $\underline{5|}$ with a retained $\underline{E|}$ in a boy nearly 15 years old. The deciduous tooth was extracted and its space maintained. Five months later, the premolar is shown to be erupting in a normal position (*Fig.* 1 B). It is worth noting that the premolar, being smaller than its predecessor, had room to manœuvre into a normal position. And it is reasonable to assume that the adjacent teeth acted as guide planes for its path of eruption, allowing the premolar to follow the direction of minimum resistance. In practice we take advantage of guide planes when trimming a monobloc, to encourage a tooth to follow a predetermined path.

The problem of atypical paths of eruption would appear to arise when the normal environment of guide planes is somehow changed. If one accepts that a tooth will erupt along the path of least resistance, then if one can lessen the resistance in a particular direction the path of eruption can be anticipated. In *Fig.* 2 there has been early loss of $\overline{|6}$, and the distal root of $\overline{|E}$ has been resorbed. As a result $\overline{|5}$ will probably erupt distally to $\overline{|E}$. *Fig.* 3 shows a similar picture one stage further, and *Fig.* 4 shows $\overline{|5}$ erupted in contact with $\overline{|7}$, after removal of $\overline{|E}$. The same process can happen in a mesial direction. *Fig.* 5 shows $\underline{5|}$ slipping forward under $\underline{E|}$, following the earlier extraction of $\underline{4|}$. The opposite side shows the distal root of $\overline{|E}$ being resorbed more rapidly than its mesial root. If the $\overline{|6}$ had been extracted, the $\overline{|5}$ may well have moved distally.

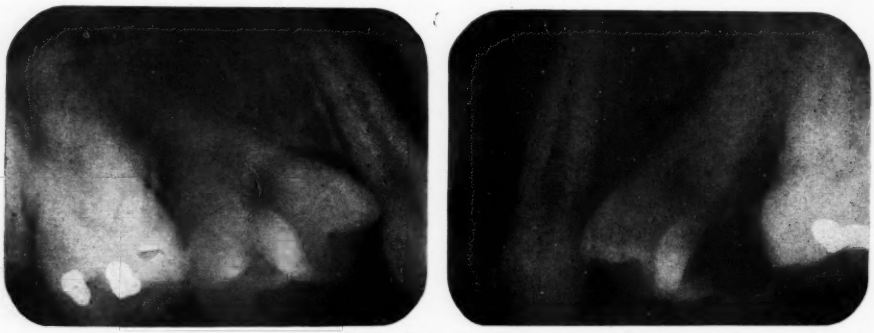


Fig. 8.—Radiographs of *Fig.* 7.

Fig. 9.—Radiographs of both sides of a case which had lost $\overline{6|6}$. Note uneven resorption of the roots of $\overline{E|}$ and relatively even resorption of the roots of $\overline{|E}$.

A corresponding picture can be found in the upper arch. In *Fig.* 6, $\underline{|5}$ can be seen erupting distal to $\underline{|E}$ subsequent to the early loss of $\underline{|6}$. The next case has a previous history of having had $\underline{D|D}$ extracted and $\underline{4|4}$ enucleated at the same time, to treat maxillary crowding. About two years later, when I first saw her, the patient had $\underline{5|5}$ erupting into $\underline{4|4}$ spaces, and $\underline{E|E}$ still retained, as shown in *Figs.* 7 and 8. In 1948 Michaelis showed a similar case, in which the condition occurred unilaterally.

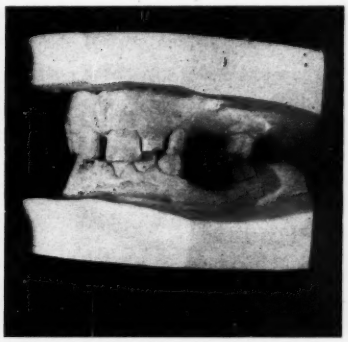


Fig. 10.—$\underline{|B}$ is retained and $\underline{|2}$ has erupted distally to it. The radiograph shows $\underline{|3}$ erupting mesial to $\underline{|2}$.

However, these effects do not occur each time one extracts a first premolar or first permanent molar. *Fig.* 9 shows radiographs of the two sides of a case that had lost $\overline{6|6}$. On the right there has been resorption of the distal root of $\overline{E|}$, and $\overline{5|}$ is beginning to move distally; on the other side there is relatively even resorption of the roots of $\overline{|E}$. The only explanation that I can offer for this change of environment is that resorption of the deciduous root nearest to the site of the extraction will be hastened where there has been infection in the socket either before or after extraction, or where there has been trauma at the time of extraction. Either of these effects would set up an irritant inflammatory reaction in the area, and this might accelerate the resorptive processes. A further danger would be if the developing premolar had a distal inclination. Once it had broken through the distal root of the second deciduous molar, there would be nothing to guide it back on its proper path (*see Figs.* 3 and 4). These points might well be considered when extractions of the four first permanent molars are contemplated.

There is another point of interest in regard to the atypical paths of eruption of premolars. Friel (1945) has said that "all teeth move forwards and none backwards". He goes on to say ". . . and I have not been able to find any evidence that teeth move backwards except when driven by an outside force, e.g., an erupting canine might drive a first premolar distally where there was room for the tooth to move". Though I would agree that the normal

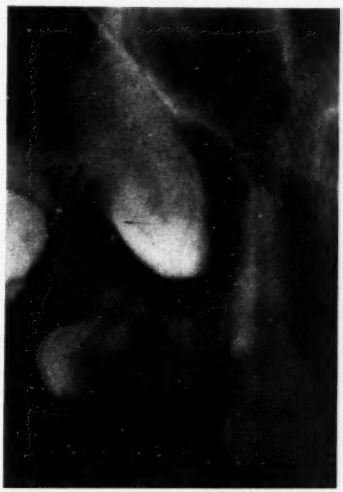


Fig. 11.—$\underline{2|}$ has erupted distally to retained $\underline{B|}$ and $\underline{3|}$ is erupting mesially to $\underline{2|}$ above $\underline{B|}$.

tendency is for teeth to move forwards, perhaps they can move distally from an inside force. That force could be the force of eruption with its direction modified by an atypical guide plane.

Now I want to draw your attention to the association between retained second deciduous incisors and transposition of canines and

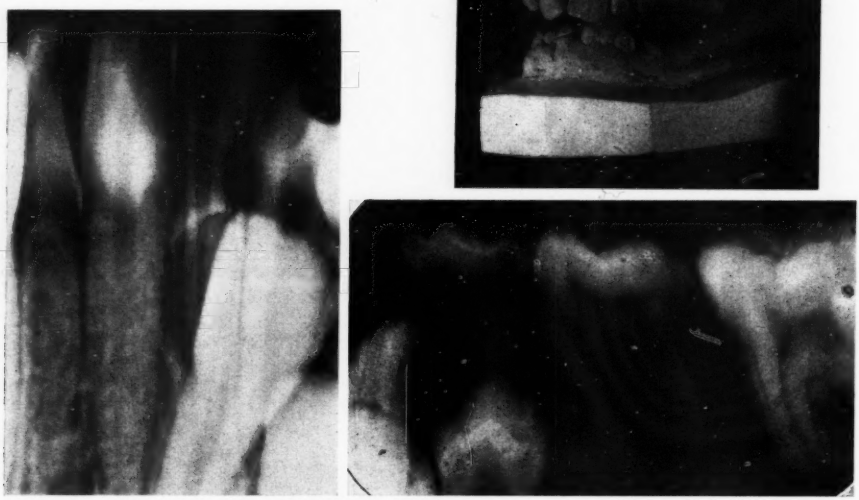


Fig. 12.—$\overline{|B}$ is retained and $\overline{|2}$ is leaning so far distally that the mesial root of $\overline{|D}$ is being resorbed by its pressure.

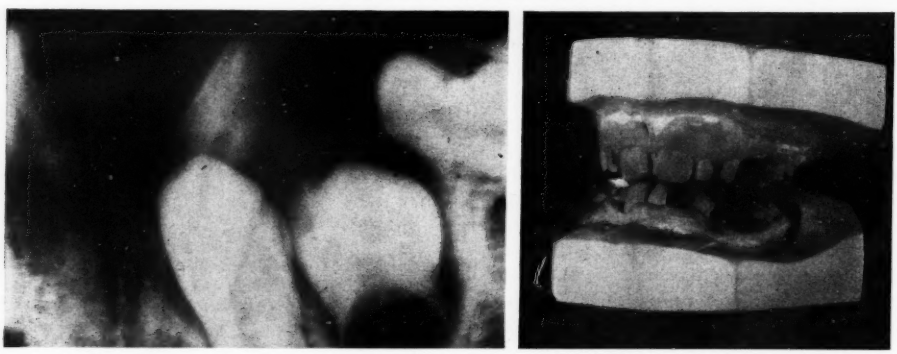


Fig. 13.—The same case as *Fig.* 12 ten months after extraction of $\overline{|BCD}$. Note that $\overline{|3}$ is erupting towards the space between $\overline{|12}$.

laterals. From time to time one comes across cases of permanent laterals erupting distal to their retained predecessors. Such a case is shown in *Fig.* 10. The permanent second incisor is now in the position of the previously lost deciduous canine. By virtue of the relatively long distance which it has to travel from its point of development, the permanent canine has considerable opportunity to be deflected off its usual path. If it should be a little more mesially inclined than usual, it

may well travel forward above the deciduous canine. Normally it would then come into contact with the lateral incisor root, and either be deflected back on to its more usual path or cause tilting of the lateral. However, if this occurs in a case like *Fig.* 10, where the deciduous lateral root has been resorbed, the canine will find a space to erupt into, and may come into the arch between the central and lateral incisor. The radiograph shows this potentiality occurring. A similar situation in another case is shown in *Fig.* 11. In *Fig.* 12, $\overline{|B}$ is retained, and in the radiograph $\overline{|2}$ is shown to be tilting distally, causing resorption of the mesial root of $\overline{|D}$. $\overline{|BCD}$ were extracted, and ten months later the situation was as shown in *Fig.* 13. From the position of $\overline{|2}$ and the inclination of $\overline{|3}$, this case has all the makings of the transposition of $\overline{|23}$.

An analogous situation is shown when a permanent lateral incisor is missing and the deciduous canine retains its proper position. Once again, if the permanent canine develops more mesially than normal, then it will be free to erupt into the empty space where the lateral should have been. The dentition will then read $\overline{4C31|}$, as shown in *Fig.* 14. This condition is seen in the upper arch as well.

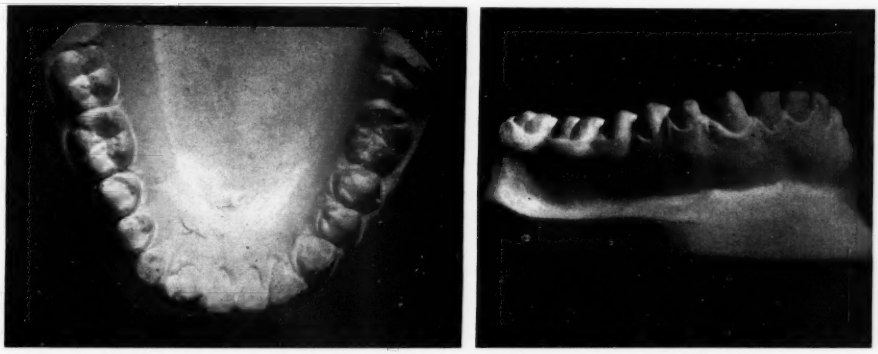


Fig. 14.—$\overline{2|}$ is congenitally missing. $\overline{3|}$ has erupted between the retained $\overline{c|}$ and $\overline{1|}$.

SUMMARY

1. An erupting premolar is guided to the surface by the roots of its deciduous predecessor and the contiguous teeth. If its environment changes then it will erupt on a different path. Some explanations of the change in environment are suggested.

2. The association between transposed canines and retained deciduous lateral incisors is pointed out.

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REFERENCES

FRIEL, E. SHELDON (1945), *Proc. R. Soc. Med.*, **38**, 456.
MICHÆLIS, M. P. (1948), *Trans. Brit. Soc. Orthodont.*, 89.
WILSON, H. E. (1952), *Ibid.*, 37.

DISCUSSION

The Chairman thanked Mr. Rose for his paper.

On the question of the retained deciduous central or lateral and the displaced permanent lateral, he asked if it might not equally be due to the position of the crypt of the permanent tooth. He was not saying that retained deciduous teeth never upset the permanent teeth, but he thought that particular case was frequently due to the developmental position of the lateral. The Chairman said that he sometimes took advantage of the tendency of teeth to erupt along the line of least resistance by

having the first premolars extracted early while the canines were still high up. The canines then tended to drop back into the space which had been created for them.

He had not been quite clear about the trimming of monoblocs. He could not see that the tiny facets would persuade the premolars to go backwards and joined issue with Mr. Rose on that point. If these facets were to have any effect, surely it would be to rotate the teeth rather than to move them backwards.

The Chairman then opened the subject for discussion.

Mr. H. G. Watkin said that he had noticed in one of the slides that the 6 had been extracted and the 5 moved distally. He thought there was no evidence of crowding at all and therefore the extraction of the 6 should not have been performed. It was most important in extraction of 6's to have definite evidence of crowding, otherwise one could get a space between two premolars.

Mr. P. H. Burke said he would like to ask whether Mr. Rose had noticed any association between transposition of maxillary canines and diminutive lateral incisors. Such transpositions might be expected, since the diminutive and retarded root of such a lateral incisor would not provide normal guidance for the eruption of the maxillary canine.

Mr. A. J. Walpole Day wanted to ask in general about the eruption of the lower premolars. He had observed many cases in which the lower 5, for example, was sloping backwards, and that appeared to be the normal pattern.

As the development of the occlusion proceeded there was a forward migration of the erupted teeth so that the roots of the E gradually uprighted the premolar underneath and subsequent radiographs showed the unerupted premolar in an upright position.

He would have liked to have seen a few slides showing the normal path of eruption of the premolar for comparison with the abnormal.

Mr. J. D. McEwen asked what relationship Mr. Rose put between the local factors and the genetic factors. He had recently had a case in Edinburgh with C3 standing and the missing 4, and when he had looked in the mother's mouth he found she had exactly the same relationship.

He also asked how much relationship there was in the cases Mr. Rose had shown. He had gained the impression from one slide that there was a missing upper lateral and in another case a missing lower 5.

Mr. F. K. Johnson asked Mr. Rose if there was any correlation between the vitality of the pulps of deciduous teeth and root resorption. He had noticed on one or two of the radiographs extensive cavities involving the pulps of those deciduous molars exhibiting imperfect root resorption; perhaps pulp infection could interfere with the normal process of resorption and thereby cause the developing tooth to be deflected.

He asked what was the objection to having spaces between premolars; he thought it could sometimes be of therapeutic and prophylactic value. Did Mr. Rose think contact points were absolutely necessary? Mr. Johnson said he knew it was not particularly relevant to the paper. but he was asking in reference to Mr. Watkin's point.

Mr. D. T. Hartley asked Mr. Rose to explain, with regard to the action of the Andresen appliance, if the guided movement of posterior teeth to which he had referred was primarily in a buccal, or in a distal, direction. He thought ambiguity on that point was the cause of some of the misunderstanding, but probably his own views were in accord with those expressed by the President.

Mr. J. S. Rose said in reply that he had been worried as to whether the radiographs could be seen, but he now realized that they could be seen only too well.

On the Chairman's point, whether the retained A or B would cause deflection directly over the erupting tooth or whether there was not an ectopic position to start with, he thought it was awfully difficult to say, except that the common point of malocclusion of the 1 or 2 was lingual and their position of development was lingual to the deciduous tooth. It would, therefore, be reasonable to say that that tooth was continued down its lingual path and the A or B which had been retained would not allow the permanent incisor to come into proper position.

With regard to trimming the facets on the monobloc, Mr. Rose said he thought it was much a matter of opinion. One could guide teeth and sometimes one did more than guide teeth, one actually put pressure on a particular point and encouraged a tooth to move in that direction. With a guide-plane one was pushing something away from one point and pushing it towards another point.

Mr. Watkins had mentioned extractions of 6's when there was no crowding. He did not want to attempt to justify the extraction of the 6's; they were what was found when the cases were first seen and the extractions were due to caries or some other factor. He did agree that there was no orthodontic indication for extraction of 6's unless there was some form of crowding.

Replying to Mr. Burke, he had not seen enough of the cases of the incisors which had been mentioned to give an answer, but he had gained the impression that some were normal laterals and some were diminutive laterals. He agreed with preventive action, but if a C was not resorbing he would be happy to have it extracted.

Mr. Rose thought there was very commonly a distal inclination to the lower 5, but he did not know that it was normal. Perhaps one had not seen them early enough. They often came slightly out of the ordinary position and the environment of the deciduous roots would guide them into position rather like the first slide where the upper premolar came down between the guide planes of the adjacent teeth. So long as everything else was normal he thought it would be self-correcting, but once one altered the balance then the trouble would start.

On the relationship between hereditary and local factors Mr. Rose thought there was a hereditary association between transposition of teeth, and other cases of that had been reported, but whether there was a hereditary local factor, hereditary position of canine teeth which it might be possible to intercept by a change in environment or whether one just had transposition of tooth germs, which was possible, he did not know.

With regard to vitality of teeth and resorption, he thought non-vital teeth also resorbed and did not appear to be very much slower than others.